Syntec VitMan©

MAINTENANCE MANUAL

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System Description

Theory of Operation

The Syntec VitMan is a complex microprocessor controlled, electromechanical system for use in support of ophthalmic surgery. Operationally it can be broken down into surgical functions or into subsystems that can be grouped together logically because of their function in the system.

The surgical functions are as follows:
Vitrector drive
Aspiration
Irrigation
Illumination
Air exchange
Ultrasound

The logically grouped subsystems are as follows:
Light source- see Illumination surgical function
Cassette housing assembly
System Pneumatics- Includes Pneumatic module
Floppy disk drive
LCD display
CPU electronics board
Analog electronics board
Ultrasound electronics board
Power supply
Speaker
System cooling
Foot pedal

Operation of the system's menus is required to access all of the features of the system. The owner's manual includes comprehensive information on the operation of the menus. This document will refer to a specific series of menu selections separated by a back slash (\). For example **Values \ Current A/D Values** signifies selecting Values from the Main menu, then selecting Current A/D Values from the Values menu. When a reference is made to a specific selection a complete listing of the menu selections will be given from the main menu, even if a shorter route from the current screen could be taken in the menu tree.

Vitrector - The vitrector surgical function provides a variable rate pressure pulse used to drive a guillotine type vitrector.

The vitrector surgical function LED (located on the front panel of the system) will display the current state of the vitrector surgical function. If the LED is dark, the vitrector surgical function is off. If the LED is green, the vitrector surgical function is operating within acceptable limits. If the LED is red a problem exists which may effect the operation of the vitrector surgical function. If the LED is red, the front panel display will show a status line message indicating the problem.

The vitrector surgical function will operate in one of two modes. The vitrector on/off button is used to change the mode of the vitrector surgical function. Each time the vitrector on/off button is pressed the mode will change. Starting with the vitrector surgical function off, if the vitrector on/off button is pressed the vitrector surgical function will come on and enter the posterior vitrectomy mode. If pressed again the vitrector surgical function will enter anterior vitrectomy mode. The vitrector up and down buttons can be used to change the vitrector cut rate setting. The vitrector cut rate setting has a range of five cuts-per-minute to twelve hundred cuts-per-minute, or it can be placed in single cut mode. If the up or

down buttons are pressed and released, the vitrector cut rate setting will change by five cuts-per-minute. If the up or down buttons are pressed and held, the vitrector cut rate setting will continue to change (in five cuts-per-minute steps) until the end of the range is reached or the button is released. If the vitrector cut rate setting is at the minimum setting, and the down button is pressed, the vitrector surgical function will enter single cut mode. While in single cut mode, if the up button is pressed, the cut rate will change to the minimum setting.

The foot pedal position is used to control when the vitrector cuts. A foot pedal side switch (left or right) is selected by the user, to enable cutting functions (ultrasound or vitrector). By specifying which switch is used to actuate reflux (**Current Settings \ Aspiration Values**), the other switch is used to enable cutting functions. The default cut enable switch is the right switch. Two modes are available for the cut enable switch, toggle or momentary (**Current Settings \ Vitrector Values**). If the user selects the toggle mode, actuating the switch will toggle the cut enable state. If cutting is enabled, it will be disabled. If cutting is disabled, it will be enabled. If the user selects momentary mode, the switch needs to be actuated to enable cutting. In addition to enabling cutting (using a side switch), the foot pedal must be depressed before cutting begins. The user is allowed to specify the foot pedal movement required before cutting begins (**Current Settings \ Pedal Thresholds**). When the foot pedal is depressed far enough that the vitrector threshold is reached, the vitrector will cut.

Several subsystems are involved in performing the vitrector surgical function (refer to figure 1). The foot pedal is the main tool available to the surgeon for control of how the system operates the vitrector. Refer to the foot pedal subsystem for details about how it operates. The foot pedal connects to the system back panel via an integral cable. A connector at the back panel makes the transition from the external cable to an internal cable.

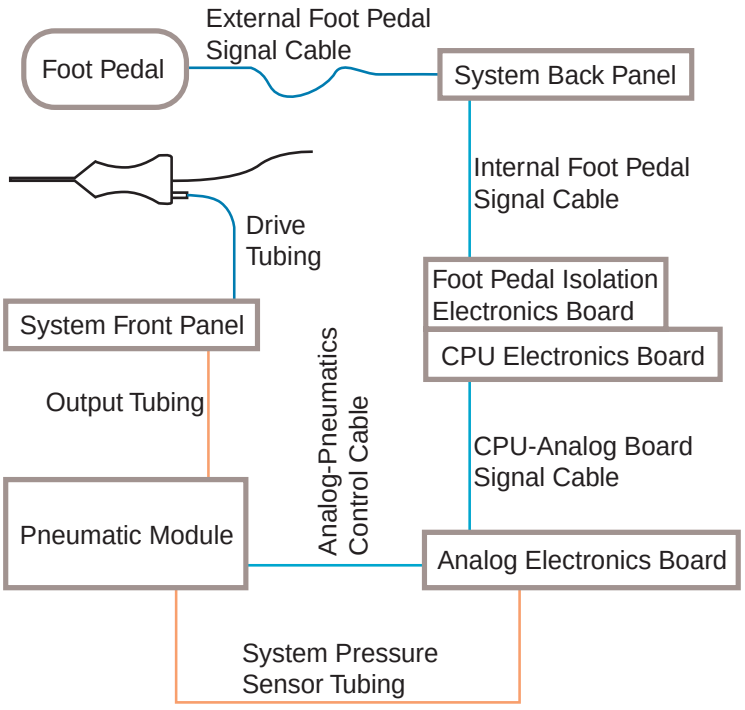


Figure 1.
Block diagram of subsystems used for the vitrector drive surgical function.

The internal cable terminates at a connector on the foot pedal isolation electronics board. The board optically isolates the foot pedal signals and passes them through a board to board connector to the CPU electronics board. The microprocessor on the CPU electronics board analyzes inputs from the foot pedal to determine what action to take. If the system pressure is OK and the foot pedal position is correct as defined in the system settings, then it will send a signal to the analog electronics board to activate the vitrector. A signal cable connects the CPU electronics board to the analog electronics board. Addresses and data are passed on this cable. The analog board decodes the command to operate the vitrector and applies ground to the appropriate pin on the analog-pneumatics cable. This cable constantly provides 12Vdc to the vitrector valve, which is turned on when the return wire is grounded. The vitrector valve is located in the pneumatic module. A tube connects the air output from the vitrector valve to the system front panel. A tube connects the main system air pressure from the pneumatic module to a sensor on the analog electronics board. The analog electronics board communicates the system pressure back to the microprocessor through the CPU-analog signal cable. The system monitors the system air pressure only. It can't determine if the vitrector valve is actually operating. Nor does it measure the pressure pulses sent from the vitrector valve.

Aspiration - The aspiration surgical function is used to provide vacuum to the connected surgical instrument.

The aspiration surgical function LED will display the current state of the aspiration surgical function. If the LED is dark, the aspiration surgical function is off. If the LED is green, the aspiration surgical function is operating within acceptable limits. If the LED is red a problem exists which may effect the operation of the aspiration surgical function. If the LED is red, the front panel display will show a status line message indicating the problem.

The aspiration on/off button is used to change the state of the aspiration surgical function. The effect on the aspiration surgical function is dependent upon the state of other surgical functions as detailed below. With either the vitrector or ultrasound surgical functions on, if the aspiration surgical function is on and the aspiration on/off button is pressed, the aspiration function will be turned off. If the aspiration surgical function is off and the aspiration on/off button is pressed, the aspiration function will be turned on. The aspiration mode used (anterior or posterior) is the mode selected by either the vitrector or ultrasound surgical function (whichever is active). With both the vitrector and ultrasound surgical functions off; the aspiration on/off button is used to place the aspiration surgical function in one of three states. Starting with the aspiration surgical function off, when the aspiration on/off button is pressed the aspiration surgical function will come on and enter posterior mode. If the aspiration on/off button is pressed again the aspiration surgical function will enter anterior mode. If pressed again the aspiration surgical function will be turned off.

Two types of vacuum control are provided, fixed and linear. While in fixed aspiration, the user can select the desired vacuum level using the aspiration up and down buttons. The foot pedal position is monitored and when the activity threshold is reached, the aspiration valve will open and selected vacuum level is applied to the surgical instrument. The activity threshold can be specified by the user (**Current Settings \ Pedal Thresholds**). In linear aspiration, the vacuum applied to the surgical instrument is proportional to the posi

tion of the foot pedal. When the activity threshold is reached, the aspiration pinch valve will open, but initially, no vacuum is applied. As the foot pedal is further depressed, the vacuum level will increase linearly, until the maximum vacuum setting is reached when the foot pedal is fully depressed. Reflux is used to apply a small positive pressure to the aspiration tubing. This small pressure is used to release any tissue trapped at the end of the surgical instrument. With the foot pedal up, the surgeon can activate the reflux function using a foot pedal side switch. Either the left or right side foot pedal switch can be selected for reflux function activation (**Current Settings \ Aspiration Values**).

The aspiration up and down buttons can be used to change the maximum vacuum setting. The up button will increase the maximum vacuum setting and the down button will decrease the maximum setting. The maximum vacuum setting has a range from zero mmHg to five hundred mmHg. If the up or down buttons are pressed and released, the maximum vacuum setting will change by five mmHg. If the up or down buttons are pressed and held, the maximum vacuum setting will continue to change (in five mmHg steps) until the end of the range is reached or the button released. While the aspiration surgical function is off, the aspiration up and down buttons will have no effect, unless a prime is in progress.

The aspiration valve open/close button can be used to open and close the aspiration pinch valve and, when pressed and held, can be used to initiate a prime cycle. If the foot pedal is not active, when the aspiration valve open/close button is pressed and released, the aspiration valve will change state. If the valve is open, it will close. If the valve is closed, it will open. If the aspiration valve is opened, using the aspiration valve open/close button, it will close after thirty seconds or if any foot pedal activity is sensed..

If the aspiration open/close button is pressed and held for one second, a prime cycle will start. A prime cycle will apply the specified vacuum level (**Current Settings \ Prime Parameters**) to the 50cc chamber of the aspiration cassette, for the duration specified (**Current Settings \ Prime Parameters**). One of two prime methods can be selected (**Current Settings \ Prime Parameters \ Prime Mode Select**). In timed prime mode, the duration of the prime cycle is determined by the prime cycle duration for the selected surgical function. In continuous prime mode, once started the prime cycle will stop when the aspiration valve button is pressed, foot pedal activity is detected or the cassette over fills. The normal method to terminate a continuous prime cycle is to press the aspiration valve button.

The aspiration cassette (refer to figure 2) is the connection between the aspiration tubing and the vacuum system. It also provides for aspirant storage. A dual chamber design is used. The larger 500cc chamber is used to store vacuum and aspirant. The smaller 50cc chamber is connected to aspiration tubing that communicates the vacuum to the surgical instrument. It's relatively small volume allows for high speed control of it's vacuum level. A float valve controls the opening of a channel connecting the two chambers. During use, approximately 25cc of fluid is allowed to enter the smaller chamber. Any additional fluid entering the smaller chamber causes the float valve to transfer an equivalent amount into the larger chamber. Two prisms are used to allow the system to sense the fluid level in each chamber. A third prism is used to reflect visible light towards the front of the cassette.

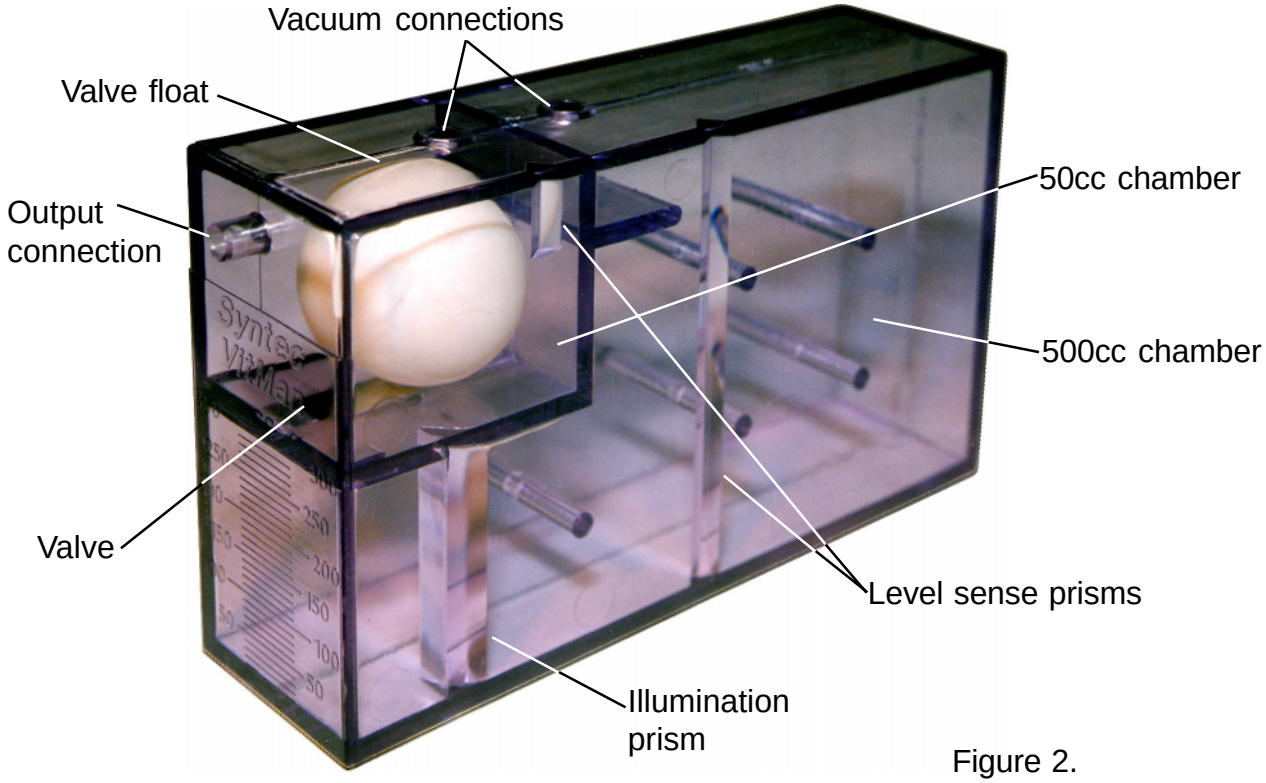


Figure 2.
Aspiration Cassette

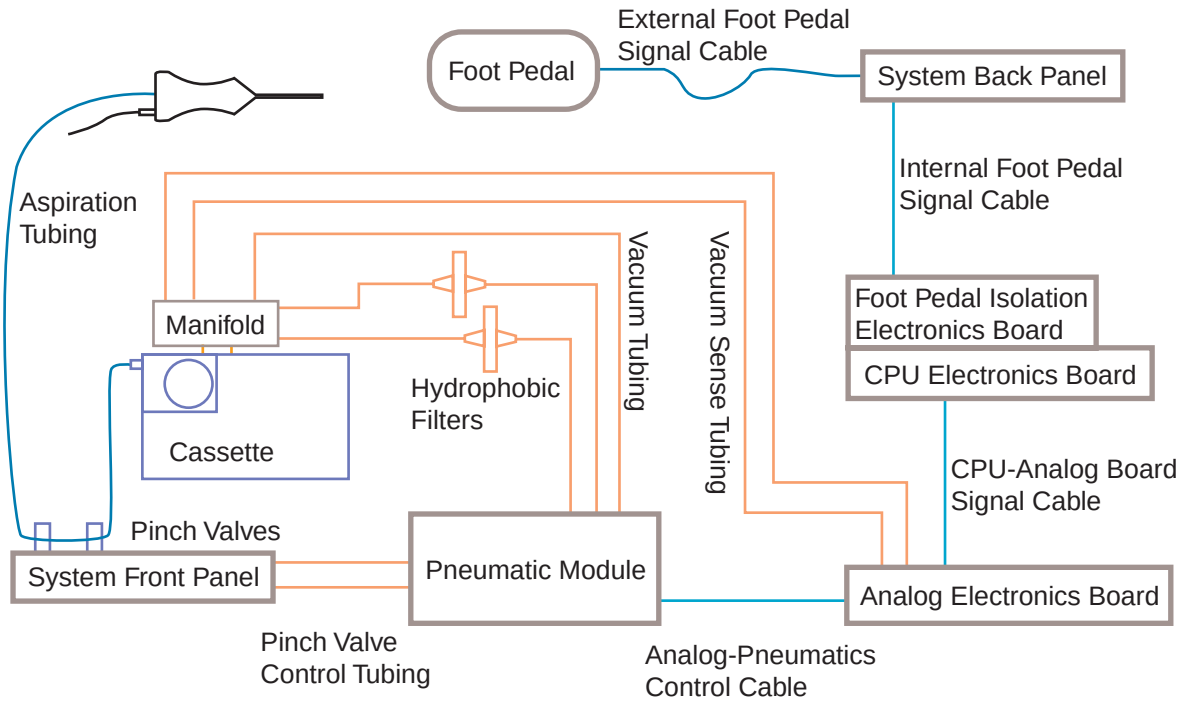


Figure 3.
Block diagram of subsystems used for the aspiration surgical function.

Various subsystems are used to perform the aspiration surgical function (refer to figure 3). The foot pedal is the primary method for controlling how the system applies vacuum. Refer to the foot pedal subsystem for details about how it operates. The foot pedal is connected to the system back panel with a cable that is permanently connected to the foot pedal. A connector at the back panel makes the transition from the external cable to an internal cable. The internal cable terminates at a connector on the foot pedal isolation electronics board. The board optically isolates the foot pedal signals and passes them through a board to board connector to the CPU electronics board. The microprocessor on the CPU electronics board analyzes inputs from the foot pedal to determine what action to take. If the foot pedal position is correct as defined in the system settings, then it will send a signal to the analog electronics board to either deliver a vacuum, change the aspiration pinch valve state, or change the reflux valve state. A signal cable connects the CPU electronics board to the analog electronics board. Addresses and data are passed on this cable. The analog board decodes the commands from the CPU electronics board. If the command is to activate one of the pinch valves (aspiration pinch valve or reflux pinch valve) then the analog electronics board applies ground to the appropriate pin on the analog-pneumatics cable. This cable constantly provides 12Vdc to the valves (in the pneumatic module) that control the pinch valves. The valves turn on when their return wire is grounded. Tubing connects the control valves in the pneumatic module to the pinch valves on the system front panel. If the command is to change the vacuum level of the smaller chamber of the cassette then the gain on a multiplying D/A converter is set and the analog signal from the foot pedal is passed through the analog-pneumatics cable to a vacuum regulator in the pneumatic module. The vacuum regulator in the pneumatic module is a closed loop V to P convertor. It takes vacuum from the larger chamber of the cassette and uses it to control the level of vacuum in the smaller chamber of the cassette. Tubing connects the cassette to the pneumatic module. The tubing includes two hydrophobic air filters to protect the system from fluid ingress. The cassette manifold provides the connection between the tubing and the cassette. Additionally the cassette manifold is connected to pressure sensors on the analog electronics board with two tubes. The sensors monitor the vacuum level of both chambers in the cassette. The analog electronics board communicates the chamber vacuums back to the microprocessor through the CPU-analog signal cable. The system monitors the vacuum level in the 50cc chamber and makes command adjustments as necessary to maintain the vacuum level requested by the foot pedal. The system monitors the 500cc chamber vacuum level and will give an error if the vacuum level measures too low.

Irrigation - The irrigation pinch valve is used to control irrigation fluid flow. While in any anterior mode, the irrigation pinch valve will open just prior to the application of aspiration vacuum and close just after vacuum is removed. The foot pedal position is used to control when the pinch valve opens. The user is allowed to specify the foot pedal movement required before the pinch valve opens (**Current Settings \ Pedal Thresholds**). While in posterior modes, the irrigation pinch valve will open (if closed) just prior to the application of aspiration vacuum and will remain open, until closed using the irrigation valve button (or by entering anterior mode). The irrigation pinch valve is to be used only in anterior modes, however, if used in posterior modes the valve will open and remain open.

The irrigation surgical function requires multiple subsystems to operate (refer to figure 4). The foot pedal is the main means available for control of how the system operates the irrigation pinch valve. Refer to the foot pedal subsystem for details about how it operates. The foot pedal connects to the system back panel with a cable integral with the pedal. A connector at the back panel makes the transition from the external cable to an internal cable. The internal cable terminates at a connector on the foot pedal isolation electronics board. The board optically isolates the foot pedal signals and passes them through a board to board connector to the CPU electronics board. The microprocessor on the CPU electronics board analyzes inputs from the foot pedal to determine what action to take. If the foot pedal position is correct as defined in the system settings, then it will send a signal to the analog electronics board to activate the pinch valve. A signal cable connects the CPU electronics board to the analog electronics board. Addresses and data are passed on this cable. The analog board decodes the command to operate the pinch valve and applies

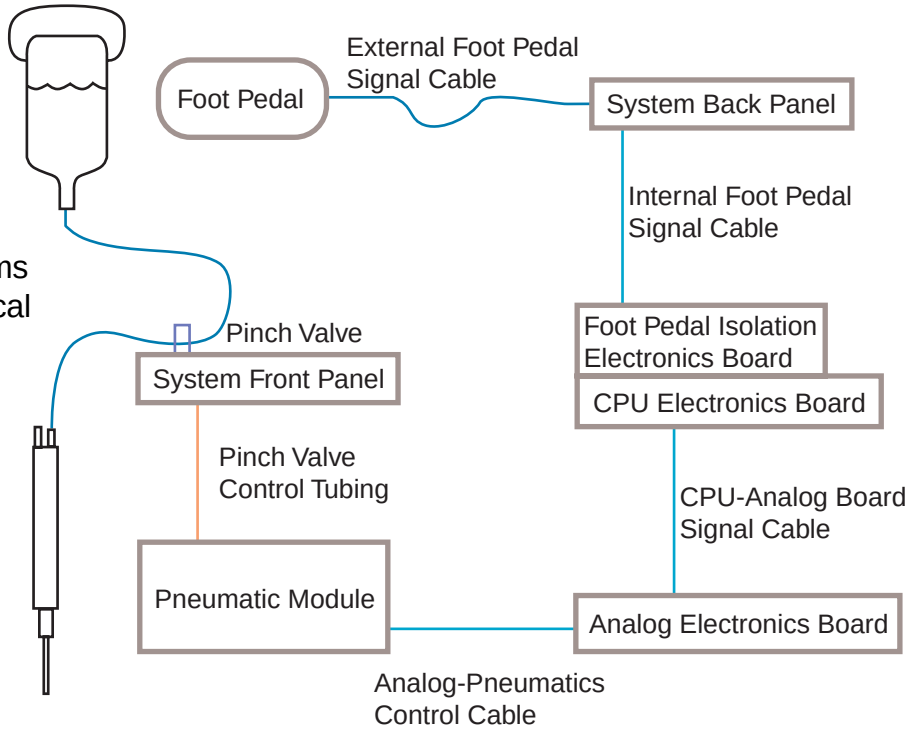


Figure 4.
Block diagram of subsystems used for the irrigation surgical function.

ground to the appropriate pin on the analog-pneumatics cable. This cable constantly provides 12Vdc to the valve (in the pneumatic module) that controls the pinch valve. The valve is turned on when it's return wire is grounded. Tubing connects the control valve in the pneumatic module to the pinch valve on the system front panel.

Illumination - The illumination surgical function is used to provide illumination for surgery through fiber optic instruments. Three fiber optic connection ports are provided. All three ports are illuminated using the same bulb. Two bulbs are available, the primary bulb and a back up bulb. The system monitors the condition of both bulbs and switches to the back up bulb when required. The system warms each bulb prior to turning it on. The user changes the intensity of the light output by adjusting the dimming knob on the light source

tray. The illumination on/off button can be used to turn on and off the illumination surgical function. When the illumination surgical function is turned on, the system will warm the bulb, then turn the bulb full on.

The system uses several subsystems to support the illumination surgical function (see figure 5). The microprocessor on the CPU electronics board analyzes inputs from the front panel controls and the current bulb status (good or bad) to determine what action to take. When a request to turn on a bulb is made, a series of commands is sent to the analog electronics board through the CPU-Analog board signal cable. The analog board decodes the commands. If the command is to move the bulb position (move a backup bulb into position) then it applies ground to the appropriate pins (2) on the analog-pneumatics cable. This cable constantly provides 12Vdc to the valves (in the pneumatic module) that control the backup mechanism in the light source. The valves are turned on when their return wires are grounded. Tubing connects the valves in the pneumatic module to the backup mechanism in the light source. The backup mechanism moves to the “A” position when the valves are off and the “B” position when the valves are on. If the command is to warm a bulb then ground is applied to the appropriate pin on the appropriate analog-bulb cable. Each bulb has it’s own power resistor, which is connected in series with the bulb to warm it prior to applying full current. The power resistors are mounted to the air duct. If the command is to turn on a bulb then ground is applied to the appropriate pin on the appropriate analog-bulb cable (different pin than the warm pin). The analog-bulb cables constantly provide 24Vdc to the bulbs. The bulb is turned on when it’s return wire is grounded. The majority of the light source components are mounted on the light source tray. This allows the light source to be opened for bulb replacement. The two analog-bulb cables terminate in a drawer style connector inside the light source enclosure. The connection is broken whenever the light source tray is opened.

The light source output connector (see figure 6) contains an integral dimming disk and the

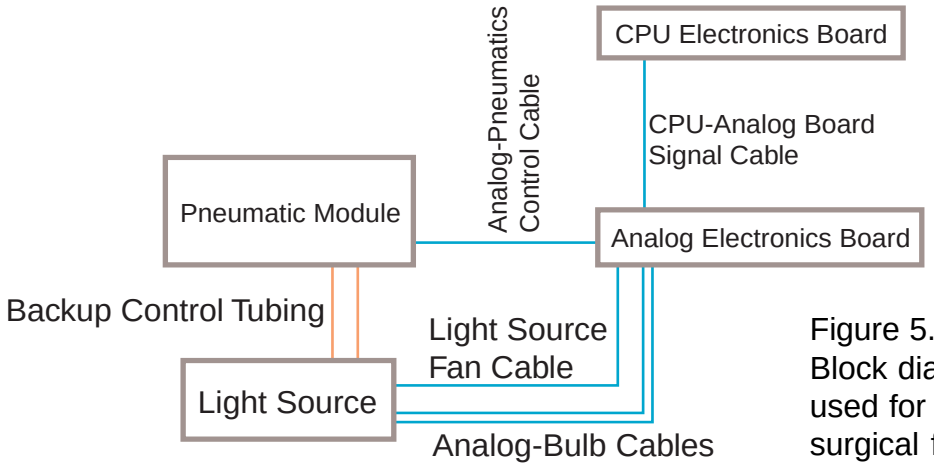
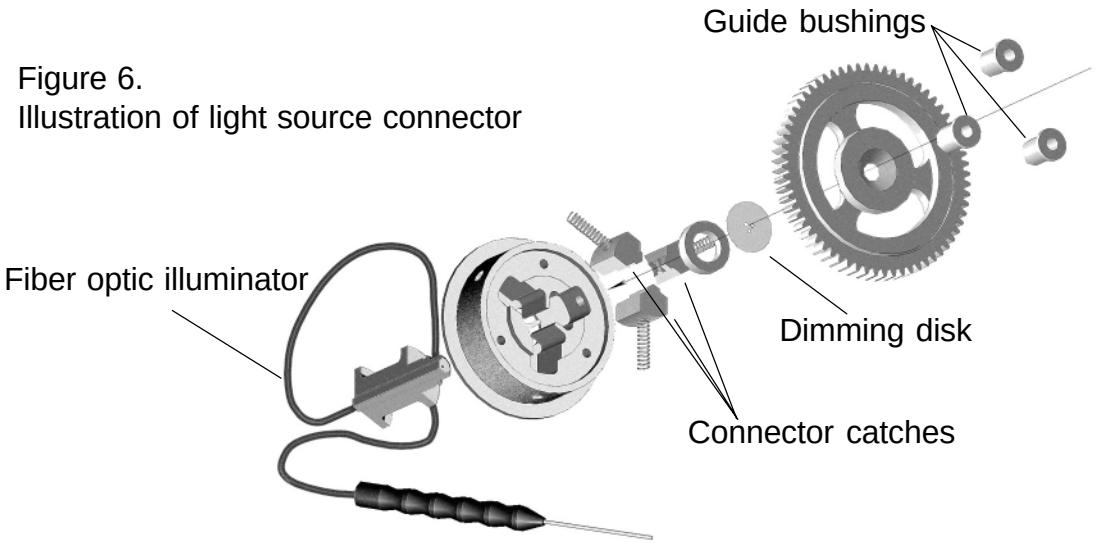


Figure 5.
Block diagram of subsystems used for the illumination surgical function.

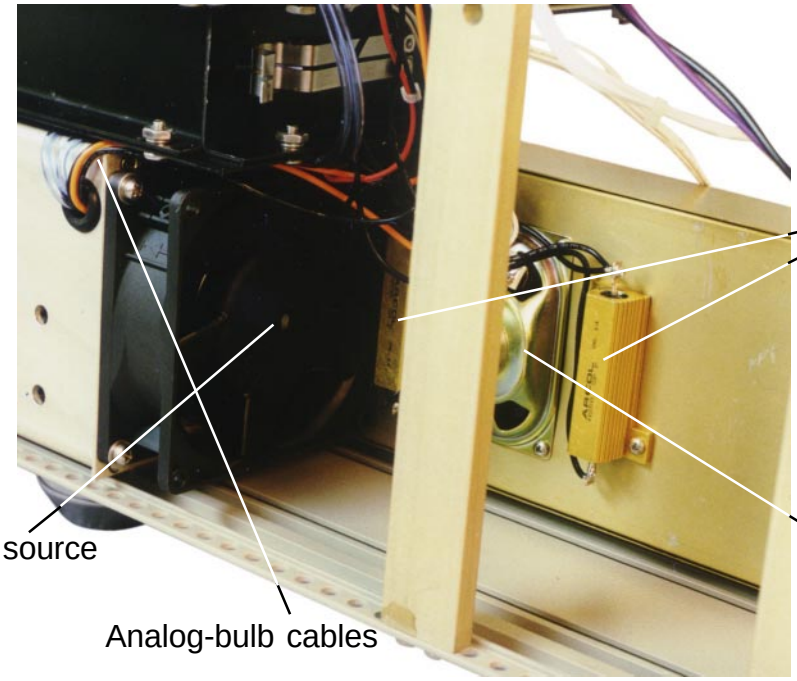
mechanism for retaining the fiber optic connectors. The light source dimming mechanism is controlled by the dimming knob located on the front of the light source tray. Rotating the dimming knob will change the position of the dimming disk relative to the ends of the fiber optic cables and change the amount of light allowed to enter the fiber optic cable.

Figure 6.
Illustration of light source connector



The light source enclosure has a fan to cool the light source optics (refer to figure 7). The light source fan pulls air from the inside of the system and forces it past the light source optics and out the air duct. The light source fan will run when the system power is on. Power for the light source fan is provided by the light source fan cable connected to the analog electronics board.

Figure 7.
Light source enclosure, bottom back



The light source tray contains the optics used to focus the light from the illuminated bulb to the ends of the fiber optic cables (refer to figure 8). Light passes through a collimating lens onto a hot mirror. The visible light which passes through the hot mirror then passes through a focusing lens onto the ends of the fiber optic cables. A spherical mirror reflects light from behind the bulb towards the front.

The light source drawer is held in the light source enclosure by the light source lock knob (refer to figure 9). When the lock knob is in the unlocked position, the light source drawer may be slid to the open position. The light source drawer stop cable (see figure 8) prevents the light source drawer from being removed from the system.

Figure 8.
Opened light source tray

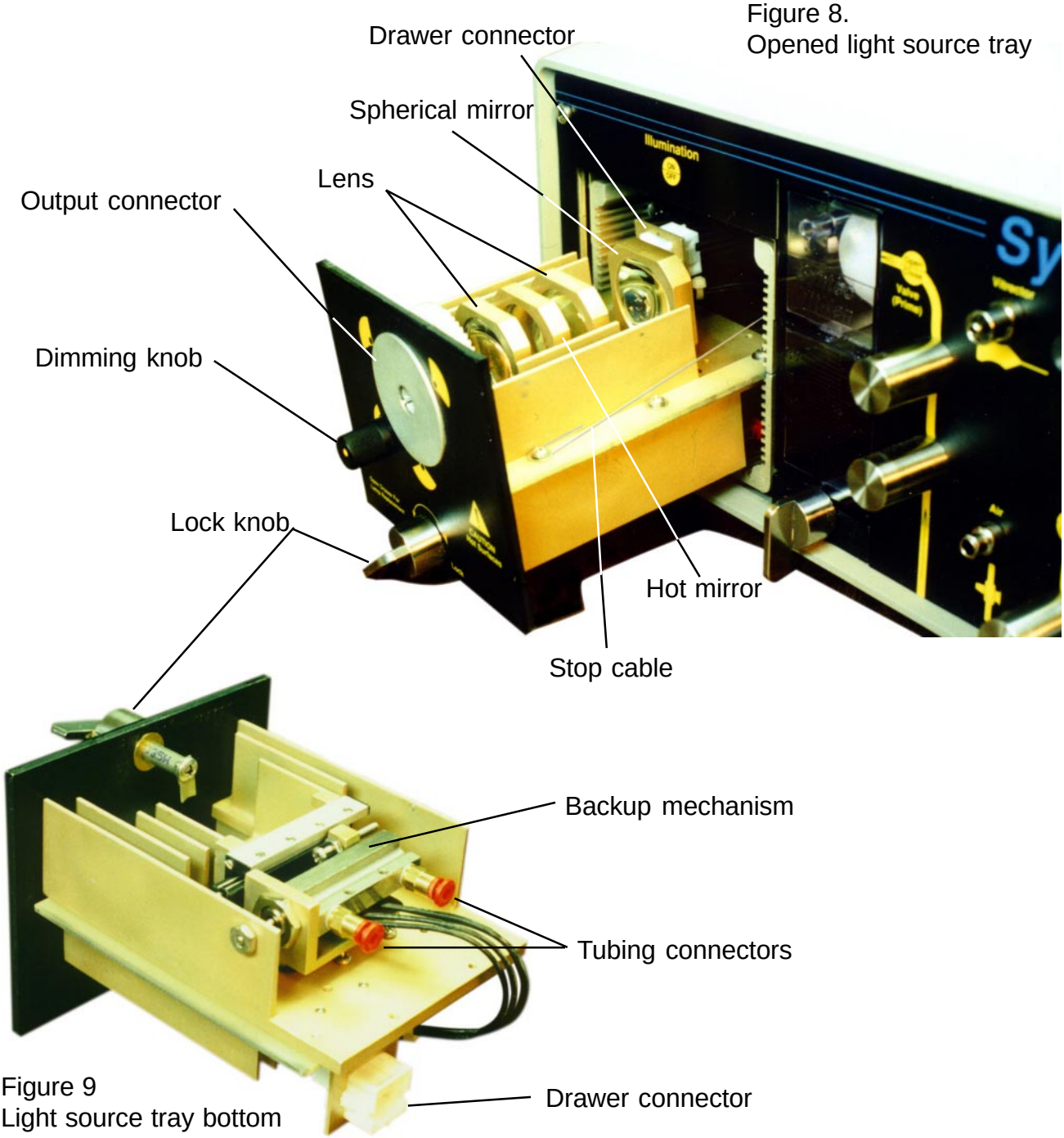


Figure 9
Light source tray bottom

Air Exchange - The air exchange surgical function is used to provide a variable flow constant pressure source of air.
The air exchange surgical function LED will display the current state of the air exchange surgical function. If the LED is dark, the air exchange surgical function is off. If the LED is green, the air exchange surgical function is operating within acceptable limits. If the LED is red a problem exists which may effect the operation of the air exchange surgical function. If the LED is red, the front panel display will show a status line message indicating the problem.
The air exchange on/off button can be used to turn on and off the air exchange surgical function. The air exchange up and down buttons can be used to change the user specified pressure setting. The up button will increase the pressure setting and the down button will decrease the pressure setting. The user specified pressure setting has a range from one mmHg to one hundred mmHg. If the up or down buttons are pressed and released, the user specified pressure setting will change by one mmHg. If the up or down buttons are pressed and held, the user specified pressure setting will continue to change (in one mmHg steps) until the end of the range is reached or the button is released. While the air exchange surgical function is off, the air exchange up and down buttons will change the user specified pressure setting.
The system uses several subsystems to support the air exchange surgical function (see figure 10). The microprocessor on the CPU electronics board analyzes inputs from the front panel controls and the current function status to determine what action to take. When the air exchange surgical function is turned on, the current output port pressure is used as the desired low pressure compressor pressure set point. A command is sent to the analog electronics board through the CPU-Analog board signal cable to enable the low pressure compressor. The analog board decodes the commands. It applies ground to the appropriate pin on the analog-pneumatics cable, enabling the low pressure compressor. It also sets the desired pressure point for the low pressure compressor control circuit which supplies a positive drive voltage to the appropriate pin on the analog-pneumatics cable. This cable connects to the low pressure compressor on the pneumatic module. A tube connects the output of the low pressure compressor to the system front panel (after it passes through a valve). Two pressure sense tubes (one for measuring pressure at the air exchange output, called “eye”, and another for measuring the compressor output pressure, called “pump”)

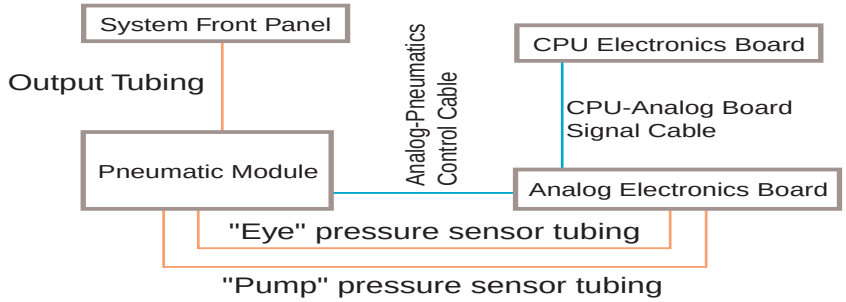


Figure 10
Block diagram of systems used for Air Exchange surgical function.

connect to sensors on the analog electronics board. The low pressure compressor control circuit on the analog electronics board uses the pump sensor output as feedback to vary the low pressure compressor drive voltage. The output of the pressure sensors is communicated back to the CPU electronics board through the CPU-analog board signal cable. When the current compressor pressure is less than ten mmHg above the initial output port pressure, the microprocessor will send a command for the air exchange valve to open. It will also send a command to change the desired low pressure compressor pressure set point to the user specified air exchange pressure setting. The analog board decodes the commands. It applies ground to the appropriate pin on the analog-pneumatics cable that connects to the air exchange valve in the pneumatic module. This cable constantly provides 12Vdc to the air exchange valve, which is turned on when the return wire is grounded. When the valve is on, output from the low pressure compressor is connected to the air exchange output on the system front panel. When the valve is off, the output from the low pressure compressor is disconnected and the air exchange output on the system front panel is blocked. Once the air exchange valve is open, if the eye sensor pressure exceeds the user specified value by fifteen mmHg, the microprocessor will command the air exchange valve to close until the pressure is reduced. If the eye sensor pressure is not within five mmHg of the user specified air exchange pressure setting, the air exchange surgical function will be in alarm (system beeps, LED goes red, and a status line message appears).

The low pressure compressor control circuit monitors the pump pressure sensor. If excessive pressure is detected by the control circuit, it will disable the low pressure compressor. This event is communicated to the microprocessor through the CPU-analog board signal cable. If excessive pressure is reported to the microprocessor, the air exchange valve will be commanded to close. If the excessive pressure condition is removed, the microprocessor will enable the low pressure compressor control circuit. When appropriate the air exchange valve will be opened. Note that this excess pressure control method is separate from the normal, software dependent, method. This method is built into the control circuit and cannot be disabled by the system software.

Ultrasound - The ultrasound surgical function is used to apply energy to an attached ultrasound handpiece. The energy can be delivered in either continuous or pulse mode. The relative power and pulse rate are specified by the user.

The ultrasound surgical function LED will display the current state of the ultrasound surgical function. If the LED is dark, the ultrasound surgical function is off. If the LED is green, the ultrasound surgical function is operating within acceptable limits. If the LED is red a problem exists which may effect the operation of the ultrasound surgical function. If the LED is red, the front panel display will show a status line message indicating the problem.

The ultrasound surgical function will operate in one of four modes. The ultrasound on/off button is used to change the mode of the ultrasound surgical function. Each time the ultrasound on/off button is pressed the ultrasound mode will change. Starting with the ultrasound surgical function off, if the ultrasound on/off button is pressed the ultrasound surgical function will come on and enter posterior fragmentation mode. If pressed again the ultrasound surgical function will enter anterior linear phaco. mode. If pressed again the

ultrasound surgical function will enter anterior fixed phaco mode. If pressed again the ultrasound surgical function will enter anterior fragmentation mode. If pressed again the ultrasound surgical function will be turned off. When the ultrasound surgical function enters a new mode, the aspiration surgical function is turned on, the aspiration mode (anterior or posterior, linear or fixed) is set to be compatible with the ultrasound mode.

The ultrasound up and down buttons can be used to change the ultrasound power setting. While in fixed power modes the setting will select the power level delivered to the hand piece, when energized. In linear power mode, the setting will select the power level reached upon fully depressing the foot pedal. If the ultrasound surgical function is on, the up button will increase the ultrasound power setting and the down button will decrease the ultrasound power setting. The ultrasound power setting has a range from one percent to one hundred percent. If the up or down buttons are pressed and released, the ultrasound power setting will change by one percent. If the up or down buttons are pressed and held, the ultrasound power setting will continue to change until the end of the range is reached or the button released. While the ultrasound surgical function is off, the ultrasound up and down buttons will have no effect.

The pulse button is used to change the state of the ultrasound pulse mode. This is a toggle operation and requires that the ultrasound surgical function be on. If pulse mode is off and the pulse button is pressed, pulse mode will be turned on. If pulse mode is on and the pulse button is pressed, pulse mode will be turned off. While the ultrasound surgical function is off, the pulse button will have no effect.

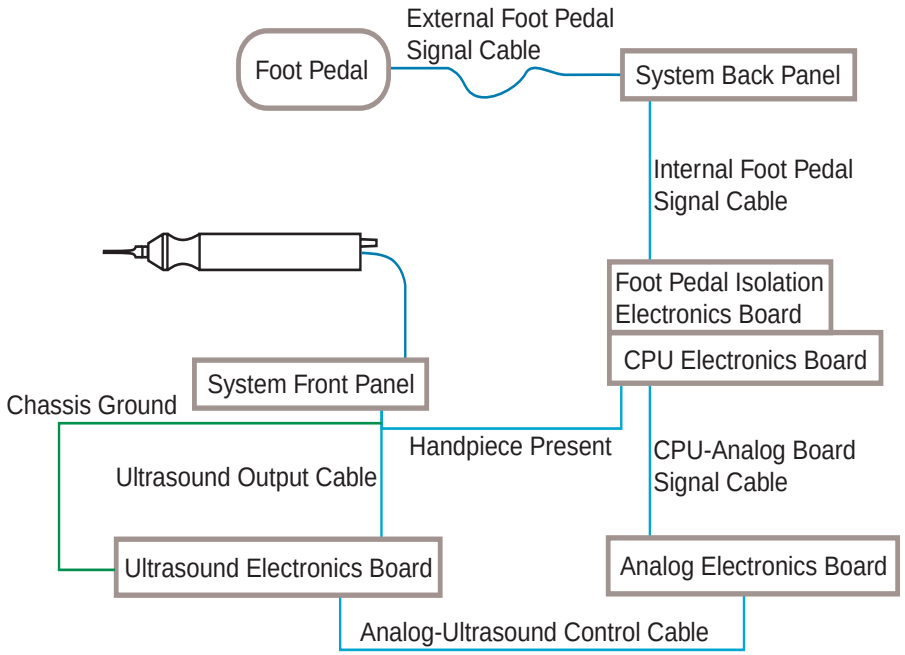
The pulse up and down buttons can be used to change the pulse rate setting. If the ultrasound surgical function is on and pulse mode is on, the up button will increase the pulse rate setting and the down button will decrease the pulse rate setting. The pulse rate setting has a range from one pulse-per-second to twenty pulses-per-second. If the up or down buttons are pressed and released, the pulse rate setting will change by one pulse-per-second. If the up or down buttons are pressed and held, the pulse rate setting will continue to change until the end of the range is reached or the button released. While pulse mode is off, the pulse up and down buttons will have no effect.

Older versions of the ultrasound electronics require that the electronics be tuned in order to transfer maximum power to the needle. New versions of the ultrasound electronics constantly tune, so maximum power is delivered to the handpiece at all times. A tune cycle scans the entire range of frequencies looking for maximum power. The frequency of maximum power is the resonant frequency of the hand piece. The tune button will initiate a tune cycle. If the ultrasound hand piece is removed from the front panel, then reconnected, a tune cycle will be required before the hand piece can be used. While the ultrasound surgical function is off, the tune button will have no effect.

The foot pedal position is used to control when the energy is delivered to the ultrasound hand piece. A foot pedal side switch (left or right) is selected by the user, to enable cutting functions (ultrasound or vitrector). By specifying which switch is used to actuate reflux (**Current Settings \ Aspiration Values**), the other switch is used to enable cutting functions. The default cut enable switch is the right switch. For ultrasound, the side switch is

only used in anterior frag. and posterior frag. modes. Two modes are available for the cut enable switch, toggle or momentary (**Current Settings \ Ultrasound Values**). If the user selects the toggle mode, actuating the switch will toggle the cut enable state. If cutting is enabled, it will be disabled. If cutting is disabled, it will be enabled. If the user selects momentary mode, the switch needs to be actuated to enable cutting. In all ultrasound modes, the foot pedal must be depressed before energy is delivered to the ultrasound hand piece. The user is allowed to specify the foot pedal movement required before cutting begins (**Current Settings \ Pedal Thresholds**). When the foot pedal is depressed far enough that the ultrasound threshold is reached, power will be delivered to the handpiece. When energy is being delivered to the ultrasound hand piece, a tone is be generated. This will provide audible feedback when energy is being delivered to the hand piece.
Several subsystems are involved in performing the ultrasound surgical function (refer to figure 11). The foot pedal is the main tool available to the surgeon for control of how the system delivers ultrasound power. Refer to the foot pedal subsystem for details about how it operates. The foot pedal connects to the system back panel via an integral cable. A connector at the back panel makes the transition from the external cable to an internal cable. The internal cable terminates at a connector on the foot pedal isolation electronics board. The board optically isolates the foot pedal signals and passes them through a board to board connector to the CPU electronics board. The microprocessor on the CPU electronics board analyzes inputs from the foot pedal to determine what action to take. If the aspiration surgical function is OK, the ultrasound handpiece is present, and the foot pedal position is correct as defined in the system settings, then it will send a signal to the analog electronics board to set the ultrasound power and activate power output. The CPU-analog signal cable connects the CPU electronics board to the analog electronics board. Ad

Figure 11.
Block diagram of subsystems used for the ultrasound surgical function.



dresses and data are passed on this cable. The analog board decodes the command to operate ultrasound and applies +5Vdc to the appropriate pin on the analog-ultrasound control cable. It also sets the desired power level by applying a 0.5-5Vdc signal to the appropriate pin on the analog-ultrasound control cable. The ultrasound electronics board receives the command and outputs power to the ultrasound output cable. This cable connects to the ultrasound output connector on the system front panel. The ultrasound handpiece connects to the front panel connector. The ultrasound handpiece has a multiple crystal piezoelectric motor. A single conductor supplies drive voltage to the motor. The return path is comprised of multiple conductors and is tied to chassis ground at the front panel. The ultrasound electronics board monitors the ground path for the handpiece. If it senses a loss of ground, it applies 5Vdc to the appropriate pin of the analog-ultrasound control cable. The analog electronics board communicates this to the CPU electronics board over the CPU-analog signal cable. The microprocessor inhibits ultrasound power output and the surgical function LED goes red. An additional connection for the ultrasound output cable connects from the ultrasound output connector on the system front panel to the CPU electronics board. It provides the handpiece present signal to the microprocessor. The microprocessor inhibits ultrasound power output and the surgical function LED will go red if the handpiece isn't connected when the surgical function is on.

Cassette Housing Assembly- Physical alignment of the various components that support the cassette is provided by the cassette housing assembly (refer to figures 12 and 13). Located on the bottom front of the housing is the lock knob. It is used to align the cassette front to back in the housing and to compress the top ports of the cassette to the seals in the cassette manifold. This is accomplished through a 270 degree rotation of the lock knob. Stops are provided at both extremes of knob rotation. The cassette manifold is

Figure 12.
Cassette housing

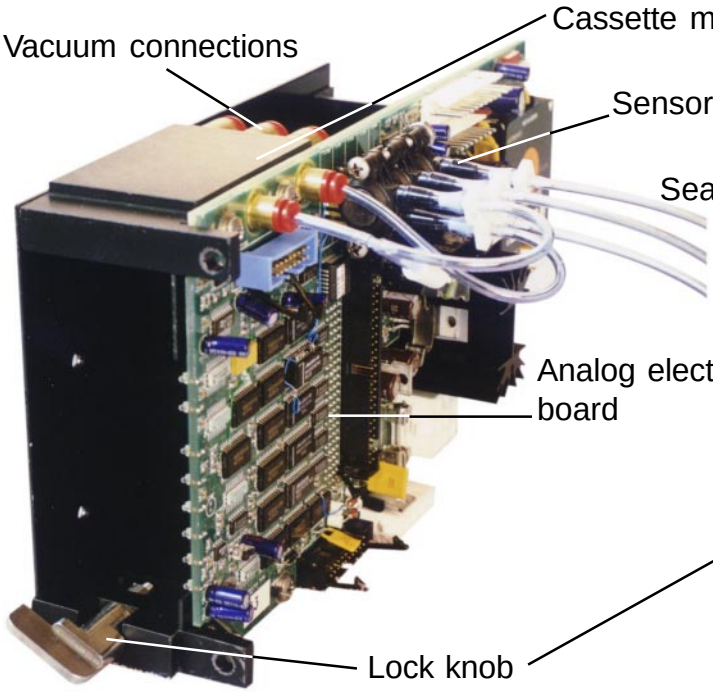
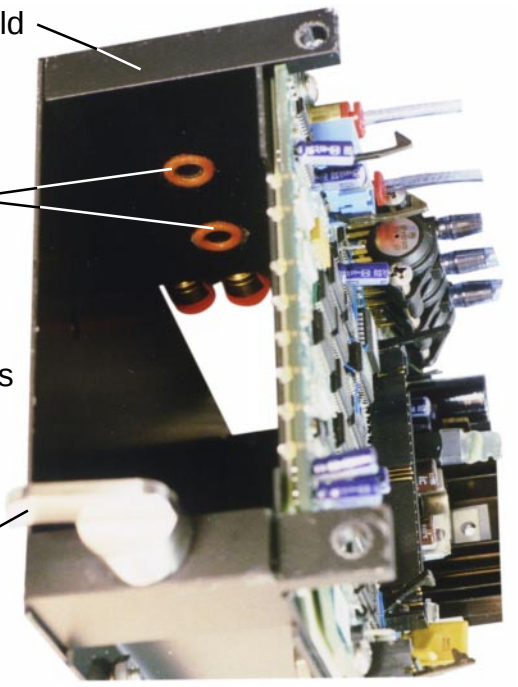


Figure 13.
View of cassette manifold seals



located towards the top front of the housing. It provides connections to the cassette, vacuum tubing, and sensors. The seals to the cassette are accomplished through O-rings mounted under the manifold. Both the manifold and the lock knob bracket are connected to the front panel providing it mechanical support. The left wall of the housing is used to mount the housing to the right side of the light source enclosure. It also contains a leaf spring that is used to hold the cassette against the right side of the housing. The rear wall also contains springs. They are used to eject the cassette after it is released by the lock knob. The right side of the housing holds the analog electronics board. The side has holes which allow LED's and optical sensors access to the side of the cassette. A series of optical sensors on the analog electronics board to monitor the prisms on the side of the cassette. Fluid in the cassette causes light to not be reflected back by the prism in the cassette. This allows the system to measure the amount of fluid in the cassette. It also allows the system to sense when a cassette is installed into the system. The front cross rail of the system mounts to the right side of the housing.

System Pneumatics - The VitMan air system affects every surgical function of the system. The **Pneumatic Module** is designed to be removed from the system as a unit for maintenance or replacement. It contains every the pneumatic component in the system that doesn't need to be elsewhere because of it's function. Refer to figure 14 for a schematic of the system pneumatics and figures 15 and 16 for a picture of the pneumatic module. Pneumatic components that are not mounted on the pneumatic module are drawn with a red outline. The various pressure sensors are all mounted on the analog electronics board. They contain the same references on the schematic as is used on the board. The three pinch valves and two function outputs (vitrector and air exchange) are mounted on the system front panel. The air cylinder is part of the light source backup mechanism. The cassette manifold is part of the cassette housing assembly, and is the connection to the aspiration cassette for vacuum control. The two filters are located to the rear of the cassette housing assembly. The pressure and vacuum input connections are mounted on the system back panel. The tubing that connects the different components is shown color coded for the size and type of tubing used. The schematic is a physical connection style schematic, the connections on the components are positioned similar to the physical connections used in the system. The bubble encapsulated numbers represent various fittings used to accomplish connections. Of special note is bubble 6. They are the quick disconnects that must be disconnected to remove the pneumatic module. Beside them is the reference used to mark the tubes for easy reassembly. If a marker is missing or illegible, refer to these references to aid assembly.

The pneumatic module contains seven valves, low pressure compressor, and the vacuum regulator that all require electrical control signals. The signals are provided by the analog-pneumatics control cable connected to the analog electronics board. Six of the valves (all except the vitrector valve) have wire connectors at the valve and an LED to indicate when the valve is on. The vitrector valve has permanently connected wiring and no indication of when it is on. All seven valves can be manually activated by pressing the button on their sides. The low pressure compressor has permanently connected wiring. The vacuum regulator wiring is connected to screw tightened terminals under the cover of the regulator. The cover can be removed by removing the two screws securing the cover to the regulator

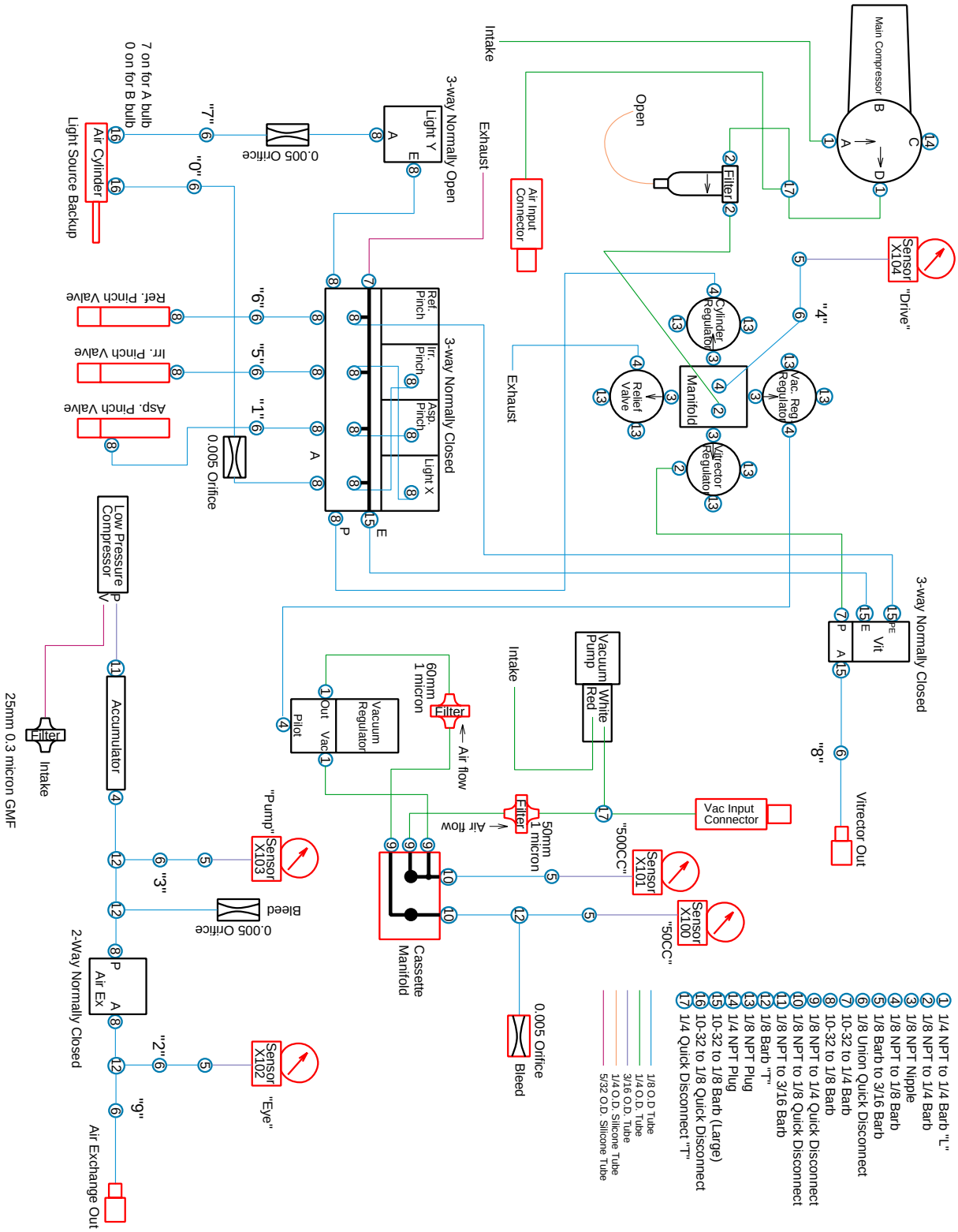


Figure 14.
Schematic of system Pneumatics

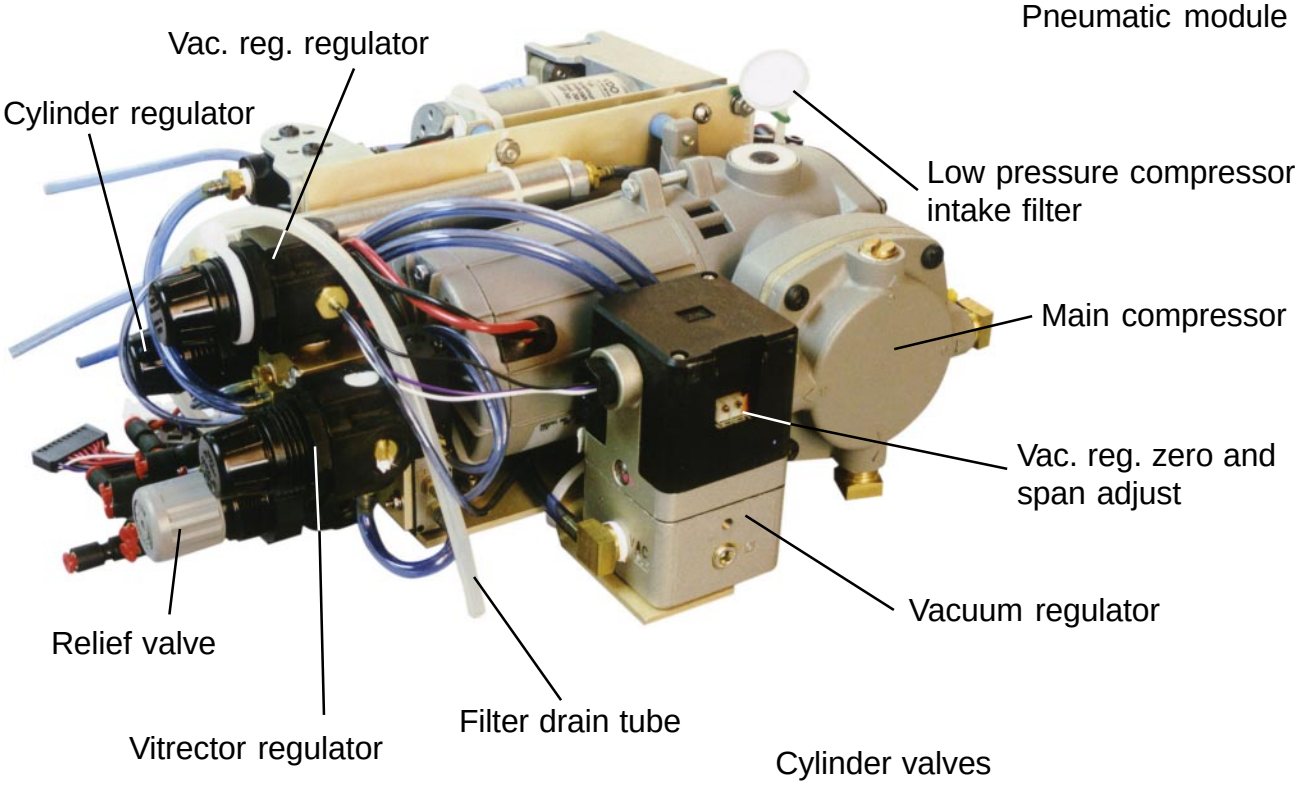
body. Power for the main compressor and vacuum pump are provided by the analog-pneumatics power cable. Both sets of wires are permanently attached to the compressor and pump.

System Pressure- The VitMan requires air pressure to operate. Two methods of providing pressure are provided. A connection for an external air pressure supply is accessible on the system back panel. The system will error if the system pressure is below 42psi. The system will vent any pressure above 50psi. Any external air supply should maintain between these two pressures. It should also be clean, dry, and oil vapor free. An internal pressure compressor is contained in the pneumatic module. The compressor will maintain the appropriate pressure under all normal operating conditions. The intake of the compressor is connected to a length of tubing, which acts as a muffler. The output of the compressor is connected via a “T” to a coalescing air filter. The other leg of the “T” is connected to the external air input connector. The external air input connector has a built in shut-off valve that is opened when a hose is connected to it on the outside of the system. This is of interest if the system is relying on it’s internal compressor and a hose is connected to the external air input connector. If the hose isn’t shut off at the distal end or if it is connected to something that represents too great of a load, then the internal compressor will be unable to provide the necessary air to the system. The valves in the compressor do not put an additional load on the external air supply. The coalescing air filter will remove any water from the air, but will not remove water vapor. Water collected is plumbed to a spot where it will not do harm. It is normal for the system in humid environments to “make” water as it operates. Water that collects as a result of decompressing the air will eventually go to one of the exhausts and evaporate. If the vitrector is operated without connecting to the output port a small amount of water may spit from the port. This is normal. The output of the coalescing air filter is connected to system pressure manifold. The manifold distributes the air to various regulators that supply the rest of the air system. Also connected to the manifold are the system pressure sensor (X104) and the pressure relief valve. The system pressure sensor measures the current operating pressure of the system. This measurement is used to ensure that the system doesn’t try to operate certain functions if the supply pressure is too low i.e. vitrector. The pressure relief valve will vent any pressure above 50 psi. It is adjustable. Operating the relief valve at greater pressure will result in a system pressure too high message on the front panel display. It also will put excess stress on the air system components.

Vitrector Drive- The vitrector pressure regulator connects to the system pressure manifold. It is adjusted to 42 psi. This pressure results in the correct pressure pulse being delivered to the vitrector. The vitrector valve is connected to the regulator. It is a 3-way, normally closed, solenoid operated, air piloted valve. Two exhausts are routed to the valve manifold. The output pressure pulses are connected to the output connector on the system front panel. Timing, pressure, and air flow have all been optimized to provide the high speed cut rate that the VitMan possesses. Kinks in either the pressure or exhaust tubes can cause performance degradation.

Air Cylinder Control- The cylinder pressure regulator connects to the system pressure manifold. It is adjusted to 30 psi. The regulated pressure output is connected to the valve manifold. This manifold directly supplies pressure to four 3-way, normally closed, solenoid

Figure 15.
Pneumatic module



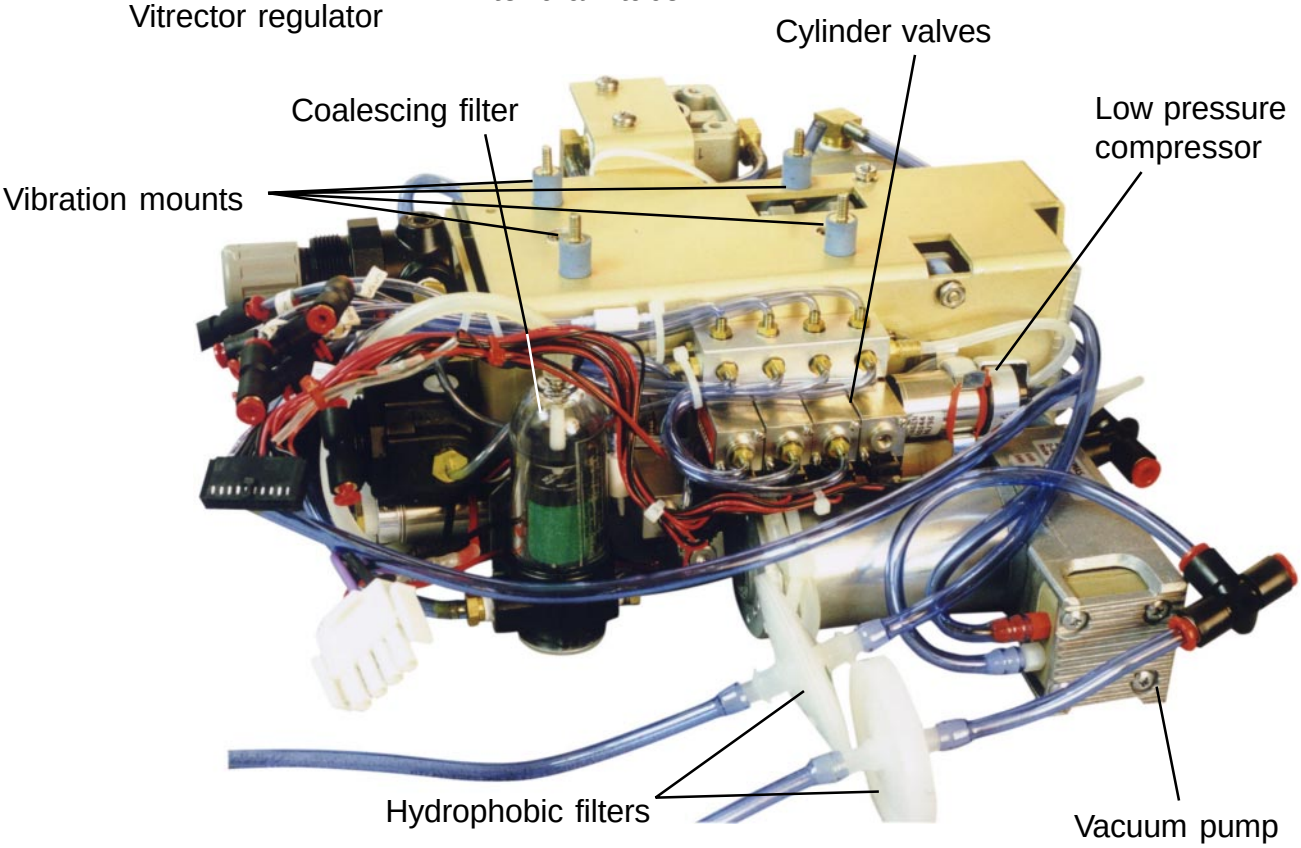


Figure 16.
Pneumatic module, bottom

operated, air piloted valves. Three of the valves are used to control air cylinders which drive the pinch valves on the system front panel. The fourth is connected to the air cylinder that is used in the light source backup mechanism. The exhausts on three of the valves is plumbed back to the valve manifold (separate from the pressure channel). The exhaust of the valve manifold is connected to a length of tubing that acts as a muffler. The pressure from the valve manifold is connected to an additional valve (Light Y). It is a 3-way, normally open, solenoid operated, air piloted valve. The valve is connected to the air cylinder in the light source backup mechanism. It works in concert with the normally closed valve (Light X), mounted on the valve manifold, to control the position of the air cylinder. Connections to the air cylinder from both valves contain an orifice. The orifices act to slow the cylinder motion.

Vacuum Regulator Pilot Pressure- The vac. reg. pressure regulator connects to the system pressure manifold. It is adjusted to 20 psi. The regulated pressure is connected to the vacuum regulator. The vacuum regulator uses this pressure to drive the internal regulation valve.

System Vacuum- The VitMan requires vacuum to operate. Two methods of providing vacuum are provided. A connection for an external vacuum supply is accessible on the system back panel. The system requires an minimum of 550 mmHg vacuum to operate correctly. An internal vacuum pump is contained in the pneumatic module. The pump will maintain the appropriate vacuum under all normal operating conditions. The exhaust of the pump is connected to a length of tubing, which acts as a muffler. The intake of the pump is connected via a “T” to the cassette manifold. The connection is protected with a hydrophobic filter. The other leg of the “T” is connected to the external vacuum input connector. The external vacuum input connector has a built in shut-off valve that is opened when a hose is connected to it on the outside of the system. This is of interest if the system is relying on it’s internal pump and a hose is connected to the external vacuum input connector. If the hose isn’t shut off at the distal end or if it is connected to something that represents too great of a load, then the internal pump will be unable to provide the necessary vacuum to the system. The valves in the pump do not put an additional load on the external vacuum supply. The cassette manifold provides the connection to the aspiration cassette (see aspiration surgical function for explanation on how the cassette operates). The cassette manifold contains a channel that connects the source vacuum to the 500cc chamber of the cassette, which acts as an accumulator.

Vacuum Output Control- The vacuum stored in the 500cc chamber of the aspiration cassette is used to control the vacuum level of the 50cc chamber of the aspiration cassette. Vacuum is routed from the cassette manifold to the input of the vacuum regulator. The vacuum regulator responds to a voltage control signal. It uses the pilot pressure to control the vacuum output. It contains an internal pressure sensor for feedback. The output of the vacuum regulator is protected with a hydrophobic filter and is then connected to the cassette manifold. The cassette manifold contains a channel that connects the output of the vacuum regulator to the 50cc chamber of the cassette. Two sensors (X101 and X100) are connected to the cassette manifold. They monitor the vacuum level in both chambers of the cassette. The system is able to modify the voltage command to the vacuum regulator to fine tune the output vacuum. The tubing connecting X100 to the cassette manifold in

cludes a “T” that is connected to an orifice. The orifice ensures that there is always a slight load on the vacuum system, even when the output of the aspiration cassette is plugged. This helps stabilize the control loop and improves response time.

Air Exchange- The components that comprise the air exchange portion of the system pneumatics are separated from the rest of the pneumatics. The air pressure source is a small rotary vane compressor. The intake of the compressor is protected by a filter. The output of the compressor is connected to an accumulator. The accumulator dampens pressure pulses. The other side of the accumulator is connected to a sensor, an orifice and a valve. The sensor monitors the output pressure of the compressor, regardless of whether the output of the air exchange surgical function is enabled or not. The orifice ensures that a slight load is always placed on the compressor. The valve is a 2-way, solenoid operated, air piloted valve. It is used to isolate the system air exchange output from the pressure source. It allows the pressure source to start and stabilize before the output is connected. It also allows the system to disconnect the output in case the pressure source exceeds allowable limits. The output of the valve is connected to a sensor and to the air exchange output connector. The sensor monitors the output pressure of the system. It allows the to compare the output to the pressure source pressure and make decisions accordingly.

Floppy Disk Drive - The floppy disk drive can be used to perform system software updates, load diagnostics, configure the system to user preferences and to record system function during surgery. Once a minute, the floppy disk drive is checked for the presence of a diskette. If a disk is present (and not locked) the system function for the past minute will be recorded. The data will be appended to the PC compatible file VITMAN.LOG. If the file does not exist, it will be created. If the data cannot be saved, it is discarded.

Several menu mode commands are available to perform actions on a diskette. The directory of a diskette may be displayed. The system software and user preferences may be saved or loaded. The file VITMAN.LOG may be deleted. A diskette may be formatted. The event log or system data may also be saved.

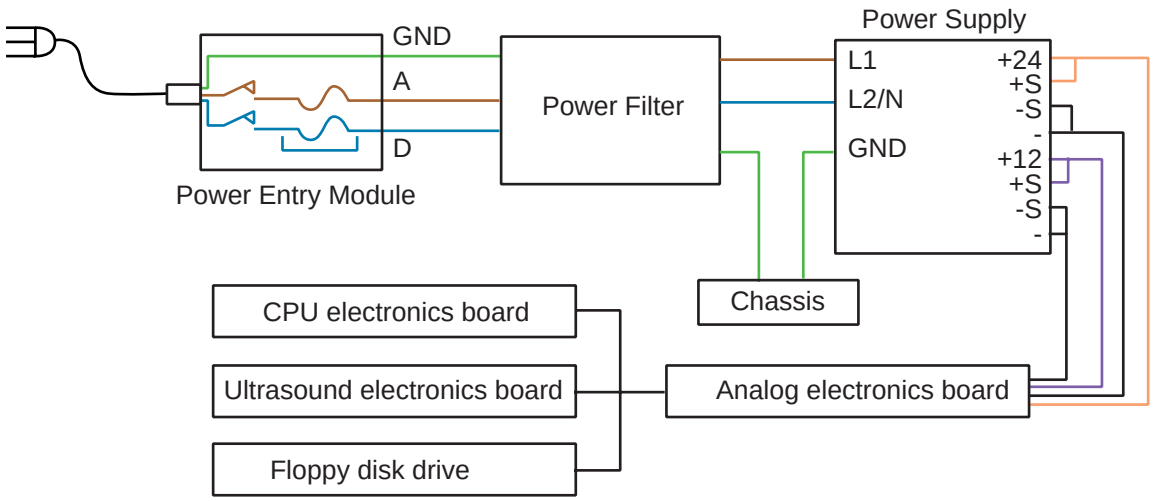
The floppy disk drive is mounted to the side of the system. It is controlled by the CPU electronics board. The CPU-floppy signal cable routes control signals to the floppy disk drive. The analog-floppy power cable is connected to the analog electronics board. It provides power to the floppy disk drive.

LCD Display - The LCD display is used to display the current settings and operational state of the surgical functions. Two modes are available, normal and menu mode. While in normal mode the state of the surgical functions is displayed. The display area is divided among the various surgical functions. The bottom line of the display area is the status line. Any problem detected will result in a message being displayed in the status line. If more than one problem exists a message will display for two seconds before changing to the next message.

Menu mode allows the user to change all aspects of the system configuration. The *Display* button is used to enter and exit menu mode. While in normal mode, if the *Display* button is pressed and held for one second, menu mode is entered. While in menu mode, pressing

the *Display* button will exit menu mode. While in menu mode, all surgical functions remain active. Only the LCD display is effected, however, values modified may effect the surgical functions. The entire menu may be traversed and all information can be displayed without using the *Enter* button. The *Enter* button is required to save any change.
While in normal mode, the user can adjust the contrast and back light intensity. The left and right arrow buttons can be used to change the LCD display contrast level. The left arrow will make the contrast darker. The right arrow will make the contrast lighter. The up and down arrow buttons can be used to change the LCD display back light intensity. The up arrow will increase the back light intensity. The down arrow will decrease the back light intensity.
The LCD electronics board is mounted to the CPU electronics board. It receives power and control signals from the CPU electronics board via a board to board connector.
Power Supply- The VitMan receives electrical power through a detachable cord that connects to the power entry module on the system back panel. The main power switch for the

Figure 17.
Block diagram of power distribution



system and the system fuse/s are contained in the power entry module. Care should be taken that the proper rating and number of fuses are installed. The power entry module is connected to the power filter, which is mounted on top of the power supply. The filter reduces conducted electrical noise. The output of the filter is connected to the AC inputs of the power supply. It is a dual output 600W “universal input” switching power supply. The power supply provides an AC OK indication which is connected to the CPU electronics board with the AC OK cable. If AC OK is lost a message is displayed in the status line, and the system attempts to do an emergency shutdown. The power supply is mounted to the system crossrails under the air duct. It provides +12 and +24 volts DC to the analog

electronics board via the analog-power supply cable. The analog electronics board serves as a power conditioning and distribution point. Unregulated +12 and +24 volts, regulated +12 and -12 volts, +5 volts, VCC, -22 volts, and various grounds are distributed from here.

Speaker - The speaker is used to generate warning and error tones at the request of the surgical functions. If enabled (**Audio Services \ Key Click**), a key click tone will be generated when a valid keyboard button is depressed. When energy is being delivered to the ultrasound hand piece, a tone will be generated. The audio volume can be adjusted (**Audio Services \ Audio Amplitude**). The speaker can be disabled (**Audio Services**). Several other options are available through menu mode.

The speaker is mounted to the bottom of the air duct behind the light source fan (refer to figure 7). The analog-speaker signal cable is connected to the analog electronics board on one end and permanently attached to the speaker at the other. A D/A channel on the analog electronics board is used by the system to generate tones. The output of the D/A is connected to an audio amplifier. The output of the audio amplifier is connected to the speaker. The gain of the audio amplifier is connected to another D/A channel.

System Cooling- The internal temperature of the system is maintained at an acceptable level by the flowing room temperature air through the system. The system fan (mounted on the system back panel) pulls in air from outside the system and forces it past the main compressor. Air circulates within the system. The light source fan (mounted on the back of the light source enclosure) draws air from inside the system and blows it into the light source. Air passes through the light source and exits the back of the system through the air duct. Directing air flow in this manner protects the rest of the system from the high temperatures developed by the light source. Both fans operate when the system power is on. The analog-fan power cables provide power to the fans. The system fan's power cable has connectors to detach from the fan. The light source fan's power cable is permanently attached to the fan. The system fan has a filter on the intake side of the fan. The filter should be monitored regularly and cleaned when it becomes dirty. A temperature sensor is located on the analog electronics board. The system will detect and report excesses in the system temperature. If the system temperature exceeds reasonable limits, the system attempts to reduce it by turning off high current draw items. If the current system temperature is 55 °C or higher, the message "Device disabled" will be displayed in the status line and an audible indication will be given. Ten seconds after this error occurs the illumination bulbs will be turned off and the pressure and vacuum pumps will be shut off.

Keyboard - The keyboard allows the user to communicate with the system. It can be used to turn on and off the surgical functions, as well as modify their operating characteristics. The keyboard is an integral portion of the front panel overlay. It is comprised of a matrix of membrane switches. A ribbon cable exits the keyboard near the top of the system and connects to the CPU electronics board.

Foot Pedal - The foot pedal allows the surgeon communicate control commands to the system. This is accomplished through rotation of the foot pedal position. An analog vertical rotation signal is produced with a linear potentiometer coupled to a gear. Refer to figure 18 for a schematic of the foot pedal wiring and figure 21 for a view inside the foot pedal.

Horizontal rotation is monitored with two switches. A cam mechanism causes horizontal rotation to “stop” in three positions. Either left or right rotation causes a switch to activate. The center position is neutral. The left and right switches are used to request reflux and enable the vitrector and ultrasound surgical functions. Vertical rotation is used to change the vacuum level in linear aspiration modes, and specify the power level for linear ultrasound. An additional switch indicates when the foot pedal is all the way up (rest position). The foot pedal up switch is used as an redundant indication that aspiration, irrigation, and

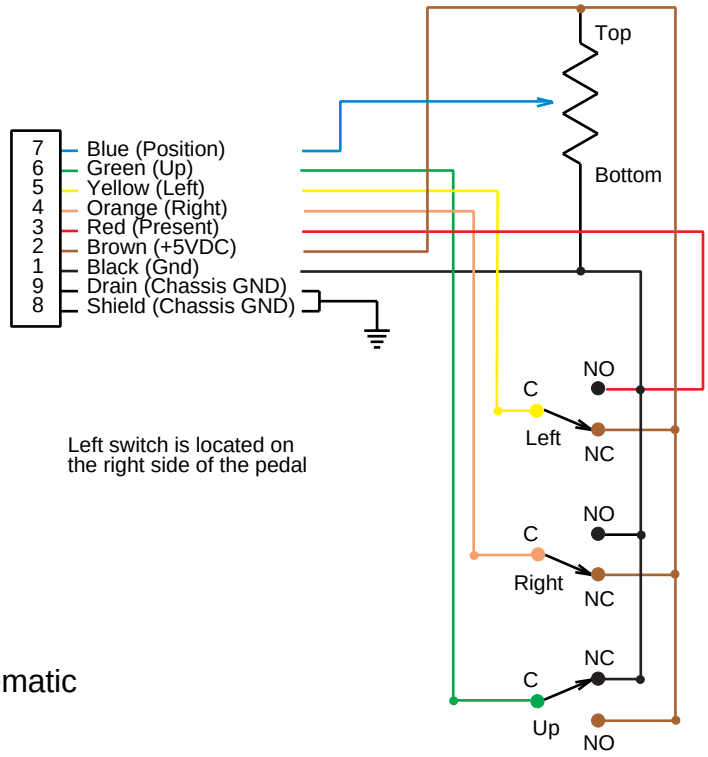


Figure 18.
Foot pedal schematic

cutting (vitrector or ultrasound) should stop.
The top of the foot pedal includes a pair of adjustable foot guides (refer to figure 19). By pressing on the lock release, located on the left front of the pedal, the guides are allowed to move. This feature allows the foot pedal to accommodate a wide range of foot sizes without causing smaller feet to slide around in between the guides. The foot guides pivot near the back of the foot pedal top. A guide rod, at the front of the foot guides, controls their position. Underneath the cover for the foot pedal top is the locking mechanism for the guide rods (refer to figure 20). When the lock release lever is depressed, the guide rods should move freely in the lock mechanism. The top of the foot pedal may be removed from the base by depressing the pivot pin located on either side of the pedal.

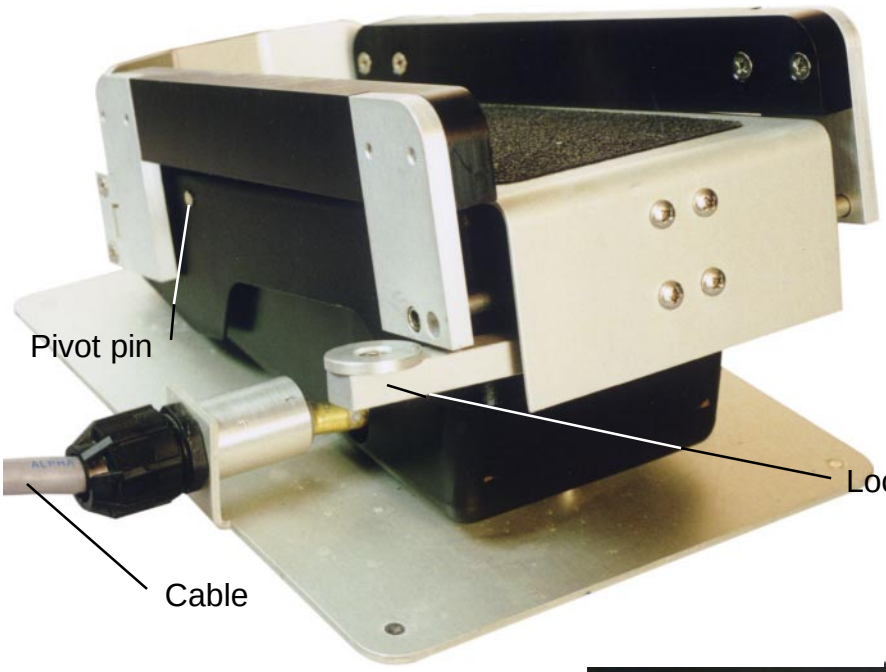


Figure 19.
VitMan foot pedal

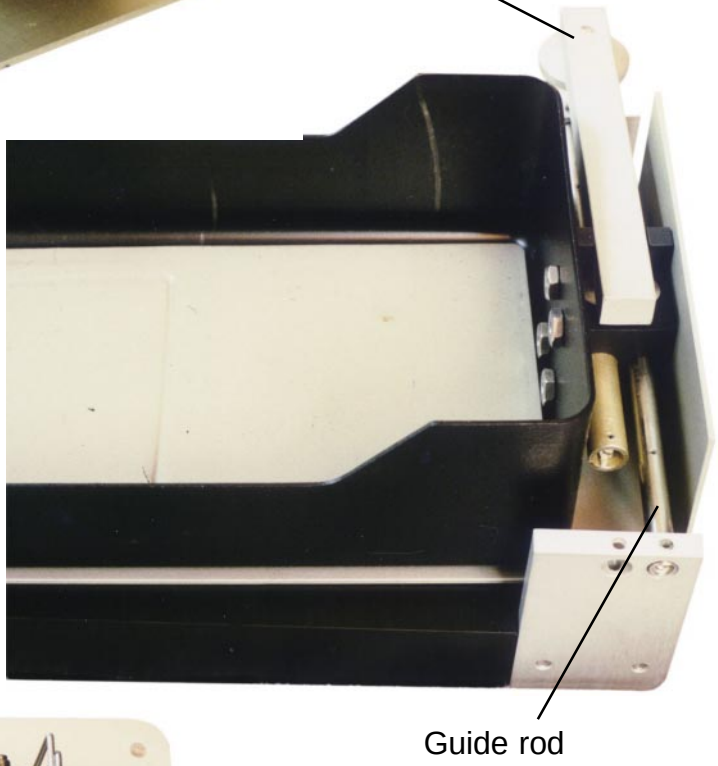


Figure 20.
Foot guide lock mechanism

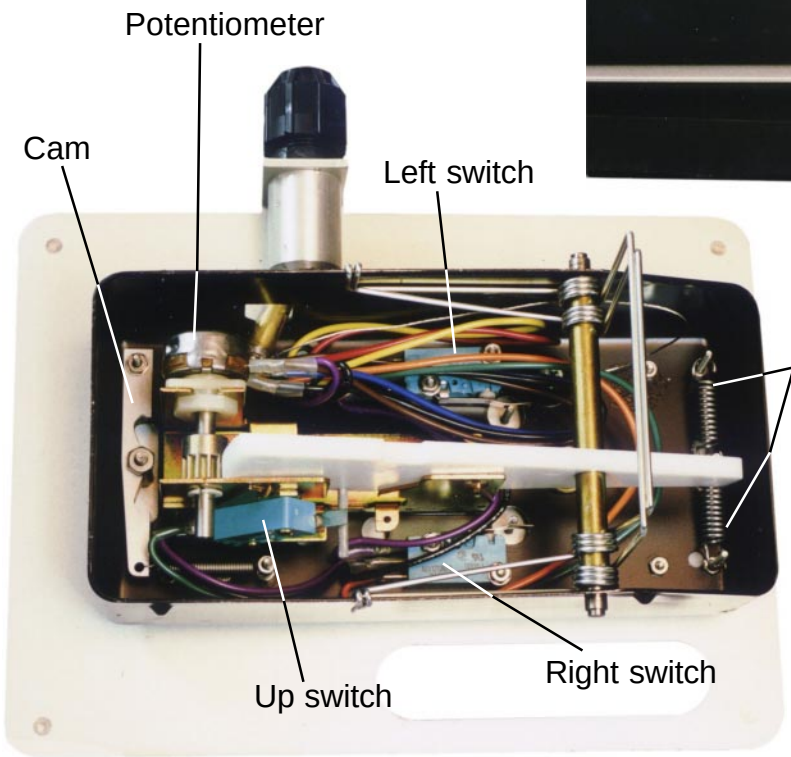
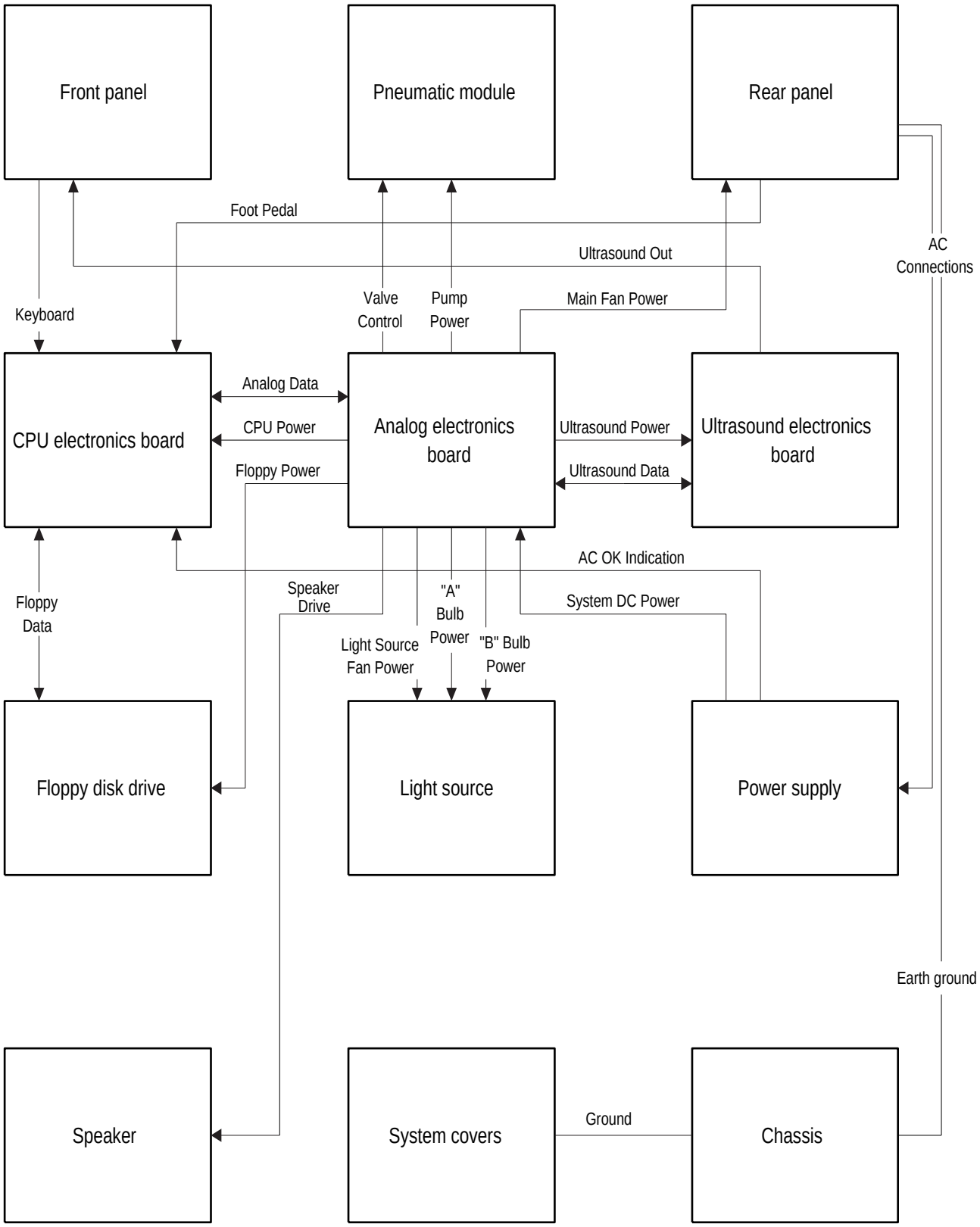


Figure 21.
Foot pedal internal mechanisms

System Interconnect Block Diagram



Connector Pinouts

CPU – Analog Signal Cable

Pin	Function
1	Bi-Directional Data Bus bit 0 (LSB)
2	Bi-Directional Data Bus bit 1
3	Bi-Directional Data Bus bit 2
4	Bi-Directional Data Bus bit 3
5	Bi-Directional Data Bus bit 4
6	Bi-Directional Data Bus bit 5
7	Bi-Directional Data Bus bit 6
8	Bi-Directional Data Bus bit 7
9	Bi-Directional Data Bus bit 8
10	Bi-Directional Data Bus bit 9
11	Bi-Directional Data Bus bit 10
12	Bi-Directional Data Bus bit 11
13	Bi-Directional Data Bus bit 12
14	Bi-Directional Data Bus bit 13
15	Bi-Directional Data Bus bit 14
16	Bi-Directional Data Bus bit 15 (MSB)
17	Ground
18	Microprocessor Write (Active Low)
19	Ground
20	Microprocessor Read (Active Low)
21	Ground
22	Address Bus bit 1
23	Address Bus bit 2
24	Address Bus bit 3
25	Address Bus bit 4
26	Address Bus bit 5
27	Address Bus bit 6
28	Microprocessor Chip Select 1 (Active Low)
29	Not Used
30	EEProm Clock
31	Microprocessor Chip Select 2 (Active Low)
32	Bi-Directional EEProm Data
33	Ground
34	Voltage from the foot pedal s internal POT
35	Cassette level LED compare voltage
36	Temperature sensor RESET (Active Low)
37	Fragmentation handpiece installed sense signal (Active LOW)
38	Temperature sensor Clock
39	Ground
40	Temperature sensor Bi-Directional Data
41	Ground
42	A/D converter End of Convert signal
43	Ground
44	A/D converter Clock signal
45	Ground
46	A/D converter Chip Select (Active Low)
47	Pedal POT supply voltage
48	A/D converter DIN signal
49	Microprocessor RESET (Active Low)
50	A/D converter DOUT signal

AC OK Cable

Pin	Function
1	To power supply AC OK +
2	To power supply AC OK -

CPU – Analog Power Cable

Pin	Function
1	+5VDC (VCC)
2	+5VDC (Analog VCC)
3	Ground (GND)
4	-12VDC (Analog -12VDC-A)
5	Ground (Analog GND)
6	+12VDC (Analog +12VDC-A)
7	-22VDC (LCD contrast supply)
8	Not Used

CPU – Floppy Signal Cable

Pin	Function	Direction
1	Change Reset (Active Low)	To Disk
2	Disk Change (Active Low)	From Disk
3	Ground	
4	In Use (Active Low)	To Disk
5	Ground	
6	Not Used	
7	Ground	
8	Bi-Directional Data Bus bit 7	
9	Ground	
10	Bi-Directional Data Bus bit 9	
11	Ground	
12	Bi-Directional Data Bus bit 11	
13	Ground	
14	Not Used	
15	Ground	
16	Bi-Directional Data Bus bit 15 (MSB)	
17	Ground	
18	Step Direction (Active Low)	To Disk
19	Ground	
20	Step Command (Active Low)	To Disk
21	Ground	
22	Disk Write Data	To Disk
23	Ground	
24	Disk Write Command	To Disk
25	Ground	
26	Track 0 sense	From Disk
27	Ground	
28	Microprocessor Chip Select 1 (Active Low)	To Disk
29	Ground	
30	Disk Read Data	From Disk
31	Ground	
32	Disk Head Select (Active Low)	To Disk
33	Ground	
34	Disk Change (Active Low) [Alternate pin]	From Disk

Analog - Floppy Power Cable

Pin	Function
1	+5VDC
2	Ground
3	Ground
4	+12VDC

Analog - Bulb Cable

Pin	Function	Connection
1	+24VDC to bulb	+24VDC via F106
2	Bulb WARM return	Return for bulb via power resistor
3	Bulb return	Switched to ground

Analog - Pneumatics Power Cable

Pin	Function	Connection
1	+12VDC Power to Vacuum Pump	+12VDC via F101
2	Vacuum Pump Return	Switched to ground
3	+12VDC Power to Main Compressor	+12VDC via F102
4	Main Compressor Return	Switched to ground

Foot Pedal Signal Cable (internal)

Pin	Function
1	Ground
2	+5VDC pedal supply via fuse F2
3	N/C
4	Pedal Installed *
5	Pedal Right*
6	N/C
7	Pedal Left*
8	Pedal Down* (Not used)
9	Pedal UP*
10	Pedal Position

* This signal is active when the line is near 0Vdc

Analog - Fan Power Cable

Pin	Function
1	+12VDC via F104
2	Ground

Analog - Speaker Cable

Pin	Function
1	To speaker +
2	To speaker -

Analog - Ultrasound Power Cable

Pin	Analog Board Connector	Pin	Ultrasound Board Connector
1	Not Connected	1	Not Connected
2	Not Connected	2	Not Connected
3	Not Connected	3	Not Connected
4	Not Connected	4	Not Connected
5	Not Connected	5	Not Connected
6	Not Connected	6	Not Connected
7	Not Connected	7	Ground (GND)
8	Ground (GND)	8	Ground (GND)
9	+24VDC (via F109)	9	Not Connected
		10	Not Connected
		11	Not Connected
		12	Not Connected
		13	+24VDC (via F109)
		14	+24VDC (via F109)

Analog – Power Supply Cable

Pin	Function	Feeds Fuses
1	+12VDC	F104, F105, F113
2	+12VDC	F100
3	+24VDC	F103, F106, F109
4	Ground	
5	Ground	
6	Ground	
7	+12VDC	F102, F101
8	+12VDC	
9	Ground	

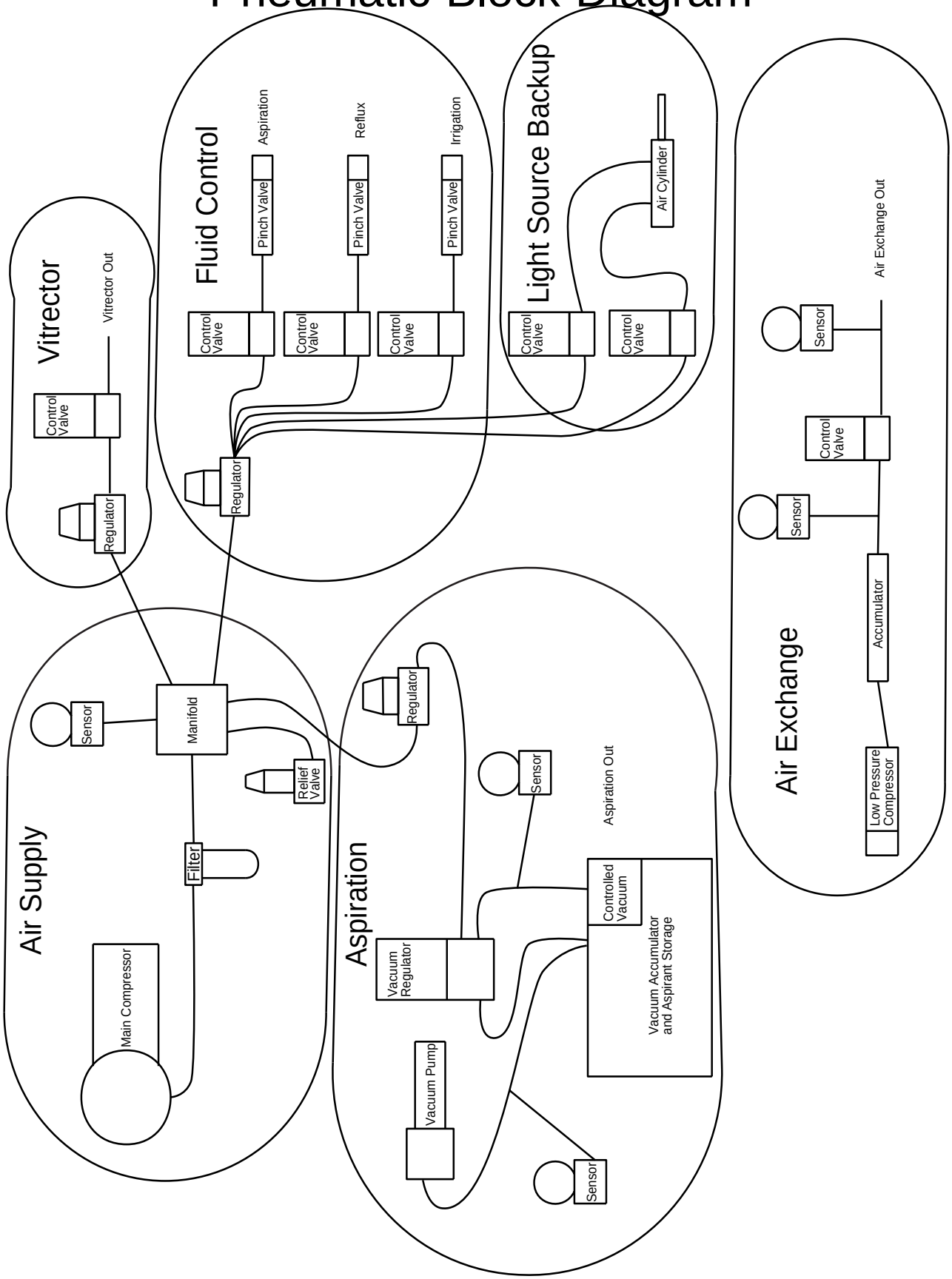
Analog - Pneumatics Control Cable

Pin	Function	Connection
1	Vacuum Control Signal (0-5VDC)	To Vacuum Regulator
2	+12VDC	Power to Vacuum Regulator
3	Ground	Return to Vacuum Regulator
4	No Connection	
5	Vitrector Valve Return	Switched to ground to activate the vitrector valve
6	Vitrector Valve Power	+12VDC via F100 power to the valve
7	Aspiration Pinch Valve Return	Switched to ground to activate the pinch valve
8	Aspiration Pinch Valve Power	+12VDC via F100 power to the valve
9	Reflux Valve Return	Switched to ground to activate the pinch valve
10	Reflux Valve Power	+12VDC via F100 power to the valve
11	Irrigation Valve Return	Switched to ground to activate the pinch valve
12	Irrigation Valve Power	+12VDC via F100 power to the valve
13	Air Exchange Valve Return	Switched to ground to activate the valve. Enables air output.
14	Air Exchange Valve Power	+12VDC via F100 power to the valve
15	A/B Bulb Backup Valve Return	Switched to ground to activate the valve. Simultaneous to pin 17.
16	A/B Bulb Backup Valve Power	+12VDC via F100 power to the valve
17	A/B Bulb Backup Valve Return	Switched to ground to activate the valve. Moves light source backup.
18	A/B Bulb Backup Valve Power	+12VDC via F100 power to the valve
19	Air Exchange Motor Return	Switched to ground via two 3.9V zener diodes to drive the Air Exchange motor
20	Air Exchange Motor Power	0 to +22VDC depending on the pressure desired.

Analog - Ultrasound Control Cable

Pin Ultrasound Board Conn.	Function	Pin Analog Board Conn.
1	Not Connected	
2	Ground	13
3	Not Connected	
4	Not Connected	
5	Not Connected	
6	Not Connected	
7	Ground Fault, low=grounded	8
8	Not Connected	
9	Not Connected	
10	Not Connected	
11	Power Control (+0.5-5.0VDC)	14
12	Not Connected	
13	Power Output Enable, active high	6
14	Not Connected	
15	Not Connected	
16	Not Connected	

Pneumatic Block Diagram



Status Line Messages

The status line of the LCD display will show information concerning the current state of the device. All error and warning conditions will generate a status line message. In addition to error and warning messages, informational messages are displayed as well. This list contains all types of status line messages, sorted in alphabetical order. Following each message is an explanation of, and in some cases a possible solution to, the condition being reported.

dd-mmm-yy hh:mm:ss
The date and time will display when the date & time is selected for the status line default and no other messages need to be displayed. The status line default may be selected using the “Status Line Default” command in the “Display” menu. The date and time can be modified using the “Date & Time” menu, found in the main menu. The date and time are used to time stamp any files created.

Dr. Cutright
The user name will display when the user name is selected for the status line default and no other messages need to be displayed. The status line default may be selected using the “Status Line Default” command in the “Display” menu. The user name can be modified using the “Edit User Name” command, found in the “Select User” menu.

+12 volt fuse problem
The +12 volt fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the +12 volt power is not present. In addition to the fuse opening, this message could be caused by a problem with the DC-DC converter that generates the +12 volt power.

-12 volt fuse problem
The -12 volt fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the -12 volt power is not present. In addition to the fuse opening, this message could be caused by a problem with the DC-DC converter that generates the -12 volt power.

-22 volt fuse problem
The -22 volt fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the -22 volt power is not present. The -22 volt power is used to generate the contrast for the LCD display. If the -22 volt power is not present it is unlikely that this message will be legible. In addition to the fuse opening, this message could

be caused by a problem with the DC-DC converter that generates the -22 volt power or the absence of the +12Vdc-Main voltage. The +12Vdc-Main voltage is fused and monitored.

500cc sensor problem

The vacuum sensor used to monitor the vacuum pump pressure is indicating a problem. If the aspiration cassette is present and the vacuum level is zero or if the aspiration cassette is missing and pressure is present, this message will be displayed in the status line. This message may appear along with the “Low vacuum level”, “Check cassette tubing” and “Please lock cassette” messages, when the aspiration cassette is present but not locked.

This message indicates that the 500cc sensors output voltage appears to be low. The 500cc sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the vacuum level present on the sensors port. If the voltage read is less than the previously recorded voltage present at atmosphere, then pressure may be present on the sensor, the A/D converter may have a problem or the sensor may have a problem. A leak in the vacuum system may also cause this message.

50cc sensor problem

The vacuum sensor used to monitor the small chamber of the aspiration cassette is indicating a problem. If the aspiration cassette is present and the vacuum level is zero (when vacuum should be present) or if the aspiration cassette is missing and pressure is present, this message will be displayed in the status line.

This message indicates that the 50cc sensors output voltage appears to be low. The 50cc sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the vacuum level present on the sensors port. If the voltage read is less than the previously recorded voltage present at atmosphere, then pressure may be present on the sensor, the A/D converter may have a problem or the sensor may have a problem. A leak in the aspiration system may also cause this message.

Air exchange xxx mmHg

While the desired air exchange pressure is modified, the current eye pressure will be displayed in the status line, where “xxx” is the value of the eye pressure.

Air exchange excess

When the air exchange pressure exceeds the warning pressure limit for a time longer than the warning time limit, this message is displayed in the status line. The warning pressure limit and the warning time limit may be adjusted using the “Air Exchange Values” menu in the “Current Settings” menu.

Air exchange problem

If the air exchange valve is open, the pressure difference between the eye pressure sensor and the air exchange pump pressure sensor should be less than 15 mmHg (for low flow rate conditions the pressure difference will be close to zero mmHg). If a pressure differ

ence of 15 mmHg or greater is detected, this message will be displayed. This message will appear along with the “Service required” message.

Air exchange set: xxx
While the air exchange surgical function is on, the pressure setting is displayed in the status line, where “xxx” is the pressure setting value in mmHg.

Air pump fuse problem
The air exchange pump fuse on the analog board has opened. This fuse is not resettable and will need to be replaced in order to clear the problem.

This message indicates that the +24 volt power is not present on the air exchange pump control circuitry. This fuse also protects the audio circuitry. The speaker will not operate if the fuse has failed. In addition to the fuse opening, this message could be caused by a problem with the +24 volt output of the power supply.

Air pump hours excess
The run time on the air exchange pump has exceeded the maximum limit. The pneumatics module needs to be serviced. The “Display Pump Hours” command, found in the “Service Pneumatics” menu of the “Service Menu”, can be used to display the current air pump hours.

If the air exchange pump hours exceed 2000, this message will be displayed. While the air exchange surgical function is on this message is disabled.

Air pump problem
The test of the air exchange pump indicates that it may not be capable of generating pressure. This message may be accompanied by the “Air pump fuse problem” or the “Service required” messages.

At power-up, a test is made of the ability of the air exchange pump to generate pressure. If pressure is not detected at power-up, the test will be run each time the air exchange surgical function is enabled. If the test fails, this message will be displayed.

Air sensor problem
The pressure sensor used to monitor the air pump used in the air exchange surgical function is indicating a problem. If the air exchange surgical function is off and vacuum is present or if the air exchange surgical function is on and no pressure is present, this message will be displayed in the status line.

This message indicates that the air exchange pump sensors output voltage appears to be low. The air exchange pump sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the pressure level present on the sensors port. If the voltage read is less than the previously recorded voltage present at atmosphere, then vacuum may be

present on the sensor, the A/D converter may have a problem or the sensor may have a problem. A leak in the air exchange system may also cause this message.

Alarm cut off
While not in menu mode, the ENTER button will allow alarm cut off. Pressing and releasing the ENTER button will mute any currently playing alarm or warning tone. This is normally only required when the error or warning tones are in continuous mode. The error and warning tone modes may be adjusted using the “Audio Services” menu.

Anterior Aspiration
This message indicates that the aspiration surgical function has entered anterior aspiration mode, using the aspiration on/off button.

Anterior Fixed Phaco
This message indicates that the ultrasound surgical function has entered the anterior fixed phaco mode, using the ultrasound on/off button.

Anterior Frag
This message indicates that the ultrasound surgical function has entered the anterior frag mode, using the ultrasound on/off button.

Anterior Linear Phaco
This message indicates that the ultrasound surgical function has entered the anterior linear phaco mode, using the ultrasound on/off button.

Anterior Linear Rate
This message indicates that the vitrector surgical function has entered anterior linear cut rate mode, using the vitrector on/off button.

Anterior Vitrectomy
This message indicates that the vitrector surgical function has entered the anterior vitrectomy mode, using the vitrector on/off button.

Bulb “A” FET problem
If bulb “A” is present and enabled but is not illuminated, this message will be displayed in the status line. A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. This message indicates a hardware problem that requires servicing.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the status of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is greater than 2.5 volts while the bulb is enabled, this message will be displayed. If the A/D converter has a problem and reports a high voltage while the bulb is enabled, this message will be displayed.

Bulb “A” hours xxx
This is the in use time for bulb “A”, where “xxx” is in hours. This message will be displayed when the illumination surgical function is turned on, and the current bulb is bulb “A”.

Bulb “A” large hours
When the VitMan is powered up or if illumination is turned on while bulb “A” is selected, this message will be displayed if the bulb “A” hours exceed 40 hours.

Bulb “A” missing
If bulb “A” is not detected when the VitMan is powered up, this message will be displayed.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is less than 2.5 volts, if the A/D converter has a problem and reports a low voltage, if the bulb power fuse is open or if the +24 volt output of the power supply is not present, the bulb will not be detected.

Bulb “A” open
When bulb “A” is not detected, this message will be displayed in the status line. The most likely solution is to replace the bulb.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is less than .03 volts, this message will be displayed. If the A/D converter has a problem and reports a low voltage, this message will be displayed. The power to the bulbs is fused and if the fuse is open this message will be displayed. In addition to the fuse opening, this message could be caused by a problem with the +24 volt output of the power supply.

Bulb “A” problem
If the bulb detection logic indicates bulb “A” is on, while the illumination surgical function is off, this message will be displayed in the status line.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If illumination is off and the voltage across the FET is greater than .03 volts, but less than 2.5 volts, or if the A/D converter has a problem and reports a voltage within this range, this message will be displayed. If illumination is on this message will not be displayed.

Bulb “B” FET problem
If bulb “B” is present and enabled but is not illuminated, this message will be displayed in the status line. A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. This message indicates a hardware problem that requires servicing.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the status of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is greater than 2.5 volts while the bulb is enabled, this message will be displayed. If the A/D converter has a problem and reports a high voltage while the bulb is enabled, this message will be displayed.

Bulb "B" hours xxx
This is the in use time for bulb "B", where "xxx" is in hours. This message will be displayed when the illumination surgical function is turned on, and the current bulb is bulb "B".

Bulb "B" large hours
When the VitMan is powered up or if illumination is turned on while bulb "B" is selected, this message will be displayed if the bulb "B" hours exceed 40 hours.

Bulb "B" missing
If bulb "B" is not detected when the VitMan is powered up, this message will be displayed.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is less than 2.5 volts, if the A/D converter has a problem and reports a low voltage, if the bulb power fuse is open or if the +24 volt output of the power supply is not present, the bulb will not be detected.

Bulb "B" open
When bulb "B" is not detected this message will be displayed in the status line. The most likely solution is to replace the bulb.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If the voltage across the FET is less than .03 volts, this message will be displayed. If the A/D converter has a problem and reports a low voltage, this message will be displayed. The power to the bulbs is fused and if the fuse is open this message will be displayed. In addition to the fuse opening, this message could be caused by a problem with the +24 volt output of the power supply.

Bulb "B" problem
If the bulb detection logic indicates bulb "B" is on, while the illumination surgical function is off, this message will be displayed in the status line.

A field effect transistor (FET) is used to sink the bulb current and illuminate the bulb. The bulb detection logic uses the voltage across the FET to determine the presence of the bulb. The voltage across the FET is read using an A/D converter. If illumination is off and

the voltage across the FET is greater than .03 volts, but less than 2.5 volts, or if the A/D converter has a problem and reports a voltage within this range, this message will be displayed. If illumination is on this message will not be displayed.

Bulb fuse problem
The illumination fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the bulb power is not present. In addition to the fuse opening, this message could be caused by a problem with the +24 volt output of the power supply.

Calibrate air pump
If the tables used to regulate the air exchange operation are invalid, this message will be displayed in the status line. If this message is displayed, it is recommended that the air exchange be calibrated before use. The air exchange can be calibrated using the “Calibration Routines” found in the “Service Menu”.

Calibrate aspiration
If the tables used to regulate the aspiration operation are invalid, this message will be displayed in the status line. If this message is displayed, it is recommended that the aspiration surgical function be calibrated before use. Aspiration can be calibrated using the “Calibration Routines” found in the “Service Menu”.

Calibrate foot pedal
If the values used to regulate the foot pedal operation are invalid, this message will be displayed in the status line. If this message is displayed, it is recommended that the foot pedal be calibrated before use. The foot pedal can be calibrated using the “Calibration Routines” found in the “Service Menu”.

Cassette full
If the cassette level detection logic determines that the aspiration cassette is full, this message will be displayed in the status line. This is the second level of warning and occurs after about 300 cc of fluid are aspirated.

Cassette over full
If the cassette level detection logic determines that the aspiration cassette is over full, this message will be displayed in the status line. This is the last level of warning and occurs after about 325 cc of fluid are aspirated. When this condition is detected the vacuum pump will stop and aspiration is no longer possible. Replacement the aspiration cassette is recommended.

Cassette position bad
If the cassette level detection logic determines that the aspiration cassette is not properly aligned, this message will be displayed in the status line. This generally indicates that the cassette is pushed into the cassette chamber prior to rotating the knob into the lock position. To correct the problem, rotate the knob to the unlocked position then back to the

locked position without pressing on the cassette. The “Re-position cassette” and “Use locking knob only” messages will also be displayed.

Cassette problem

If a high fluid level is detected in the small chamber of the aspiration cassette, this message will be displayed in the status line. This condition will stop the vacuum pump and prevent the use of aspiration. If this condition is suspected to have been detected in error, remove the aspiration cassette, wait for one second, and reinsert the aspiration cassette. If the condition persists, replace the aspiration cassette. The “Replace cassette” message will also be displayed.

This message could be caused by fluid drops on the 50cc chamber prism. It could also be caused by a failure of the cassette valve. If the valve doesn’t open, then the fluid level will eventually cover the prism. Mechanical alignment of the analog electronics board could cause this message to display when using functional cassettes. The analog electronics board should be aligned directly against the inside of the front panel of the system enclosure.

Check cassette tubing

If the foot pedal is in the rest position and the vacuum level in the 500cc chamber falls below 400 mmHg, this message will be displayed in the status line. This may be the result of using the aspiration surgical function or requesting a prime cycle, with no tubing connected to the aspiration cassette. This message may appear along with the “Low vacuum level” and “Please lock cassette” messages.

When the aspiration surgical function is on and the foot pedal is in the rest position, an attempt is made to keep the 50cc chamber vacuum level at 1 mmHg. If tubing is not present, the vacuum level of the 500cc chamber may be reduced to below an acceptable value. If trying to keep the 50cc chamber at 1 mmHg causes a reduction in the 500cc chamber vacuum level, the “Check cassette tubing” status line message will be displayed. If the vacuum level is reduced during normal use, this status line message should not be displayed.

Check external source

This message will be displayed if a problem is detected with the system pressure or vacuum level and the external connections are selected for use. If the pressure compressor mode is set to external pressure or auto select and the “Low system pressure” or “High system pressure” status line messages are displayed, this message will also be displayed. If the vacuum pump mode is set to external vacuum or auto select and the “Low vacuum level” status line message is displayed, this message will also be displayed. The most likely cause of this message is that the hose(s) are connected to the VitMan, but not to the external source of pressure (or vacuum). The user should check the external connections, and if connected, then check the external source pressure levels.

Contrast adjust
While not in menu mode, the LEFT ARROW and RIGHT ARROW can be used to adjust the contrast of the LCD display. This message will be displayed as the contrast is adjusted.

Currently in stage 1
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage one, this message will be displayed in the status line.

Currently in stage 2
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage two, this message will be displayed in the status line.

Currently in stage 3
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage three, this message will be displayed in the status line.

Currently in stage 4
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage four, this message will be displayed in the status line.

Currently in stage 5
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage five, this message will be displayed in the status line.

Currently in stage 6
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage six, this message will be displayed in the status line.

Currently in stage 7
When the stage button is pressed and released, the current stage will be displayed. If the current stage is stage seven, this message will be displayed in the status line.

Device disabled
If the internal device temperature is 55 °C or higher, this message is displayed in the status line. This message indicates an error condition and after ten seconds the surgical functions will be affected. The illumination surgical function will be turned off. The system pressure compressor and vacuum pump will be turned off, effectively disabling aspiration, irrigation, the vitrector and the ultrasound. The air exchange surgical function will remain unaffected.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem and reports a high temperature condition, this message may be displayed.

Disk available hh:mm
This is the minimum time remaining to record data on the floppy disk, where “hh” is the hours and “mm” is the minutes. After the data from the previous minute is saved on the disk, this message is displayed in the status line.

Disk space warning
If the minimum time remaining is less than 30 minutes, this message will be displayed in the status line.

Disk write protected
The write protect status of the floppy disk is checked when an attempt is made to save data on the disk. If the floppy disk is write protected, this message will be displayed in the status line.

Diskette is full
If no free space remains on the floppy disk, this message is displayed in the status line.

Diskette read problem
If the boot block, file allocation tables or root directory of the floppy disk cannot be read, this message is displayed in the status line. If this condition persists, the disk may need to be formatted.

If the data cable between the CPU board and the disk drive is faulty or if power is not present on the disk drive, this message will be displayed. The disk drive has a jumper on the drive select signal. If the jumper is missing or selecting drive 0, this message will be displayed.

Drive fuse problem
The main compressor (vitrector drive pressure) fuse on the analog board has opened. This fuse is not resettable and will need to be replaced in order to clear the problem.

This message indicates that the main compressor power is not present. In addition to the fuse opening, this message could be caused by a problem with the +12 volt output of the power supply.

Drive sensor problem
The pressure sensor used to monitor the main compressor (vitrector drive pressure) is indicating a problem. The sensor is indicating that the system pressure is zero.

This message indicates that the system pressure sensors output voltage appears to be low. The system pressure sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the pressure level present on the sensors port. If the voltage read is less than the previously recorded voltage present at atmosphere, then vacuum may be

present on the sensor, the A/D converter may have a problem or the sensor may have a problem. A leak in the system pressure may also cause this message.

Eye pressure alarm
If the air exchange surgical function is on and the current eye pressure is not within (5 mmHg of the current set point, this message is displayed in the status line.

Eye sensor problem
The pressure sensor used to monitor the eye pressure, for the air exchange surgical function, is indicating a problem. If the air exchange surgical function is off and vacuum is present or if the air exchange surgical function is on and no pressure is present, this message will be displayed in the status line.

This message indicates that the eye pressure sensors output voltage appears to be low. The eye pressure sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the pressure level present on the sensors port. If the voltage read is less than the previously recorded voltage present at atmosphere, then vacuum may be present on the sensor, the A/D converter may have a problem or the sensor may have a problem. A leak in the air exchange system may also cause this message.

Fan fuse problem
The fan fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the fan power is not present. In addition to the fuse opening, this message could be caused by a problem with the +12 volt output of the power supply.

Floppy fuse problem
The disk drive fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the disk drive power is not present. In addition to the fuse opening, this message could be caused by a problem with the +12 volt output of the power supply or the disk drives +5 volt regulator.

Foot pedal is active
When the foot pedal is active, several actions are prohibited. The user may not change the mode of the aspiration, vitrector or ultrasound surgical functions. The ultrasound handpiece may not be tuned. The aspiration valve button may not be used to open or close the aspiration valve or start a prime cycle. While in anterior mode, the irrigation valve button may not be used to open or close the irrigation valve. The stage button may not be used to change mode of the surgical functions.

Foot pedal problem
If the foot pedal down switch indicates that the foot pedal is up, but the foot pedal position indicates depression of 10% or more, this message will be displayed in the status line. This indicates a problem with the foot pedal down switch (internal to the foot pedal), the foot pedal cable or connector. The hardware that senses the foot pedal down switch may also have a problem.

The condition of the foot pedal, as measured by the system software, can be viewed using the “Calibrate Foot Pedal” command under “Calibration Routines” under the “Service Menu”.

Ground fault detected
If a ground fault is detected by the ultrasound hardware, this message will be displayed in the status line. The ground fault indicates that the ultrasound handpiece is not properly grounded. No energy will be delivered to an ungrounded ultrasound handpiece. This problem may be corrected by disconnecting and reconnecting the ultrasound handpiece.

An interruption of the ground path anywhere can cause this message to display. Check the ground connections of the ultrasound output cable at both the front and rear panels of the system. Also, the ultrasound electronics board uses the board mounting hardware to sense ground. If the mounting hardware isn’t grounded then a ground fault will be sensed. Note that the entire system chassis is part of the ground path, so the front and rear panels of the system are ground.

High cassette level
If the cassette level detection logic determines that the aspiration cassette level is high, this message will be displayed in the status line. This is the first level of warning and occurs after about 250 cc of fluid are aspirated.

High pump pressure
If the air exchange surgical function is on and the air exchange pump pressure exceeds the current set point by more than 8 mmHg, this message is displayed in the status line.

High system pressure
If the main pressure pump pressure exceeds the upper limit, this message is displayed in the status line. This is only a warning, no surgical functions will be disabled.

The nominal value for the main pump pressure is 2585 mmHg (50 psi). This message will be displayed if the main pump pressure is above 2844 mmHg (55 psi).

High temperature xx (C
If the internal device temperature is 50 °C or higher, this message is displayed in the status line. The current temperature is “xx”. This message is only a warning and no surgical functions are effected. The temperature messages may be disabled in the “Display” menu.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem and reports a high temperature condition, this message will be displayed. Under normal operating conditions, the internal temperature of the system won't reach this limit. Check for air flow restrictions around the system. Especially near the main system fan and the air duct at the rear of the system.

High vacuum level
If the aspiration surgical function is on and the 50cc vacuum level exceeds the desired level by more than 20 mmHg, this message is displayed in the status line.

Hold for menu mode
While not in menu mode, holding the DISPLAY button for one second will enter menu mode. If the button is released before entering menu mode, this message is displayed in the status line.

Hold to change bulbs
When the illumination surgical function is turned off, this message will be displayed in the status line. If the illumination surgical function is off, pressing and holding the illumination on/off button can be used to switch to the backup bulb.

Hold to enter stage 1
When the stage button is pressed and held, if stage one will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 2
When the stage button is pressed and held, if stage two will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 3
When the stage button is pressed and held, if stage three will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 4
When the stage button is pressed and held, if stage four will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 5
When the stage button is pressed and held, if stage five will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 6
When the stage button is pressed and held, if stage six will be entered when the stage button is released this message will be displayed in the status line.

Hold to enter stage 7
When the stage button is pressed and held, if stage seven will be entered when the stage button is released this message will be displayed in the status line.

Hold to save stage 1
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage one. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 2
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage two. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 3
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage three. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 4
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage four. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 5
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage five. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 6
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage six. If the stage button is continued to be held, the current system state will be saved.

Hold to save stage 7
When the stage button is pressed and held, this message will be displayed in the status line, prior to saving stage seven. If the stage button is continued to be held, the current system state will be saved.

Hold to start prime
When the aspiration valve button is pressed and released (and not held long enough to start the prime cycle), this message will be displayed in the status line.

LED/backlight adjust
While not in menu mode, the UP ARROW and DOWN ARROW can be used to adjust the intensity of the LCD display backlight and the surgical function LEDs. This message will be displayed as the intensity is adjusted.

Lift pedal to prime
To start a prime cycle the aspiration pinch valve button must be pressed and held for 1/2 second. If the foot pedal is down when a prime cycle is started, this message will be displayed in the status line.

Lift pedal to reflux
If the foot pedal is depressed to a level that allows aspiration, reflux is disabled. If reflux is attempted while aspirating, this message will be displayed in the status line.

Low air pump pressure
If the air exchange surgical function is on and the air exchange pump pressure is more than 8 mmHg below the current set point, this message is displayed in the status line.

Low system pressure
If the main pressure pump pressure is below acceptable levels, this message is displayed in the status line. When low system pressure is detected the vitrector, ultrasound and aspiration surgical functions will be disabled.

When the vitrector is used at high cut rates the volume of air consumed may cause this message to be displayed. The nominal value for the main pump pressure is 2585 mmHg (50 psi). This message will be displayed if the main pump pressure is below 2172 mmHg (42 psi). When the system is operating properly, the system pressure won't drop this low. Improper adjustment of the vitrector pressure regulator (too high), air leaks, clogged air filter, and poor compressor performance could all cause this problem.

Low temperature (xx (C
If the internal device temperature is 10 °C or lower, this message is displayed in the status line. The current temperature is "xx" and when below zero will be preceded by a minus sign (-). This message is only a warning and no surgical functions are effected. The temperature messages may be disabled in the "Display" menu.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem and reports a low temperature condition, this message may be displayed.

Low vacuum level
If the vacuum pump vacuum is below acceptable levels, this message is displayed in the status line. When this condition occurs aspiration is not disabled, however, not all levels of

vacuum may be obtainable. This message may appear along with the “Check cassette tubing” and “Please lock cassette” messages.

If the 500cc vacuum level is below the aspiration surgical function’s maximum vacuum setting or is below 400 mmHg, then this message is displayed. This message indicates that the 500cc sensors output voltage appears to be low. The 500cc sensors output voltage is read using an A/D converter. This voltage is then reduced by the voltage present when the sensors port is at atmosphere. The result represents the vacuum level present on the sensors port. If the voltage read indicates a low vacuum level the A/D converter may have a problem or the sensor may have a problem. A leak in the vacuum system may also cause this message. When the aspiration surgical function is on and the foot pedal is in the rest position, an attempt is made to keep the 50cc chamber vacuum level at 1 mmHg. If tubing is not present and connected properly, the vacuum level of the 500cc chamber may be reduced to below an acceptable value.

Main +12 fuse problem
The Main +12 fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the +12Vdc-Main power is not present. In addition to the fuse opening, this message could be caused by a problem with the +12 volt output of the power supply.

Minimum cut rate:xxxx
When the vitrector surgical function enters posterior or anterior linear rate mode this message will display the minimum cut rate, where “xxxx” is the cut rate.

No cassette present
If the aspiration cassette is not detected, this message will be displayed in the status line. While the aspiration cassette is missing, the vacuum pump is disabled and the aspiration cassette illumination is reduced.

The system uses the fluid level sensor array on the analog electronics board to detect the presence of a cassette. The 500cc chamber prism causes light to be reflected back to the sensor array. If the cassette is extremely full of fluid, the sensor array will fail to “see” the prism.

No diskette present
Once a minute the trace data is written to the floppy disk. If no floppy disk is detected in the disk drive, this message is displayed in the status line.

No foot pedal present
If the foot pedal cannot be detected, this message is displayed in the status line. Without the foot pedal, many surgical functions are inoperable. Only the air exchange and illumination will function without the foot pedal.

The foot pedal presence is sensed through the cable connected to the foot pedal. Pin 1 is shorted to pin 4 internal to the foot pedal. The condition of the foot pedal, as measured by the system software, can be viewed using the “Calibrate Foot Pedal” command under “Calibration Routines” under the “Service Menu”

No handpiece present
If the ultrasound surgical function is on and the handpiece is not present, this message will be displayed in the status line.

The handpiece presence is sensed through the cable connector. 2 pins are shorted internal to the cable connector. A connection is made between the ultrasound output connector on the front panel and the CPU electronics board to enable the system to measure for the presence of the handpiece.

No keyboard heartbeat
If the keyboard encoder does not answer a heartbeat request, this message will be displayed in the status line. The heartbeat request is made once every second. If the heartbeat request is unanswered, the keyboard encoder is reset.

No stage selected
When the stage button is pressed and released, the current stage will be displayed. If no stage was selected, this message will be displayed in the status line.

No stages enabled
If no stages (other than the current stage) are enabled, and the stage button is pressed and held, this message will be displayed in the status line. This indicates that no stage is available as the next stage

No ultrasound present
If the ultrasound option is not present when the ultrasound on/off button is pressed, this message will be displayed in the status line.

The ultrasound electronics has a serial EEPROM that holds the serial number and other parameters associated with the ultrasound surgical function. If the ultrasound data cable is disconnected, if power is not present on the ultrasound board or if the serial EEPROM has a problem, the serial EEPROM will not be detected. If the serial EEPROM is not detected or if the contents are invalid, this message will be displayed.

Now saving stage 1
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage one.

Now saving stage 2
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage two.

Now saving stage 3
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage three.

Now saving stage 4
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage four.

Now saving stage 5
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage five.

Now saving stage 6
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage six.

Now saving stage 7
When the stage button is pressed and held, this message will be displayed in the status line, when the current machine state is saved in stage seven.

Over temperature
If the internal device temperature is 53 °C or higher, this message is displayed in the status line. This message is only a warning and no surgical functions are effected.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem and reports a high temperature condition, this message may be displayed. Under normal operating conditions, the internal temperature of the system won't reach this limit. Check for airflow restrictions around the system. Especially near the main system fan and the air duct at the rear of the system.

Overpressure detected
If the current eye pressure exceeds the warning pressure limit, this message will be displayed in the status line. The warning pressure level may be adjusted using the "Air Exchange Values" menu in the "Current Settings" menu.

Pedal fuse problem
The foot pedal fuse on the CPU board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the foot pedal power is not present. The foot pedal power is a fused version the CPU boards +5 volt power.

Please lock cassette
If the aspiration cassette is present and the vacuum level is below acceptable limits, this message will be displayed in the status line. This message may appear along with the "Low vacuum level" and "Check cassette tubing" messages.

This message will be displayed if the 500cc vacuum level is below 50 mmHg, while the cassette is present. A leak in the vacuum system, a problem with the 500cc vacuum sensor or a problem with the A/D converter, may also cause this message.

Please tune handpiece
If the ultrasound surgical function is on and the handpiece is not in tune, this message will be displayed in the status line. If the handpiece is removed and replaced, it must be tuned. If the power detection logic determines that the handpiece is out of tune, the probe should be retuned.

Posterior Aspiration
This message indicates that the aspiration surgical function has entered posterior aspiration mode, using the aspiration on/off button.

Posterior Frag
This message indicates that the ultrasound surgical function has entered posterior frag mode, using the ultrasound on/off button.

Posterior Linear Rate
This message indicates that the vitrector surgical function has entered posterior linear cut rate mode, using the vitrector on/off button.

Posterior Vitrectomy
This message indicates that the vitrector surgical function has entered posterior vitrectomy mode, using the vitrector on/off button.

Power fail detected
If the main power supply detects a problem with the mains input, this message will be displayed in the status line. When this condition is detected, disk activity is inhibited for five seconds.

The system power supply provides an AC LOW indication. The AC LOW indication is used to generate a non-maskable interrupt (NMI) on the CPU.

Pressure pump hours
The run time on the main pressure pump has exceeded the maximum limit. The pneumatics module needs to be serviced. The "Display Pump Hours" command, found in the "Service Pneumatics" menu of the "Service Menu", can be used to display the current pressure pump hours.

If the pressure pump hours exceed 2000, this message will be displayed. While the vitrector surgical function is on this message is disabled.

Prime cycle aborted
This message indicates that the aspiration prime cycle was aborted. Any foot pedal activity, or pressing the aspiration valve button, will abort a prime cycle.

Prime level xxx mmHg
While a prime cycle is in progress, the aspiration up and down buttons can be used to change the aspiration level. This message will be displayed when a change is made to the prime aspiration level. The aspiration prime level is “xxx”.

Re-position cassette
If the cassette level detection logic determines that the aspiration cassette is not properly aligned, this message will be displayed in the status line. This generally indicates that the cassette is pushed into the cassette chamber prior to rotating the knob into the lock position. To correct the problem, rotate the knob to the unlocked position then back to the locked position without pressing on the cassette. The “Cassette position bad” and “Use locking knob only” messages will also be displayed.

Replace cassette
If a high fluid level is detected in the small chamber of the aspiration cassette, this message will be displayed in the status line. If this condition is suspected to have been detected in error, remove the aspiration cassette, wait for one second, and reinsert the aspiration cassette. If the condition persists, replace the aspiration cassette. The “Cassette problem” message will also be displayed.

Reverse flow detected
If the air exchange surgical function is on and the pressure on the air exchange port exceeds the desired pressure level then this message will be displayed in the status line. This generally indicates that the three way valve is incorrectly positioned to apply the saline solution to the air exchange port rather than to the infusion cannula. When this condition is detected, the air exchange valve is closed in an attempt to reduce fluid flow into the VitMan.

Service pneumatics
If the time on the pneumatics module has exceeded the maximum limit, when the VitMan is powered up this message will be displayed in the status line. The “Display Pump Hours” command, found in the “Service Pneumatics” menu of the “Service Menu”, can be used to display the current pressure pump hours.

If the pressure pump hours exceed 1000, this message will be displayed.

Service required
This message indicates that a serious problem was detected and repair of the Syntec VitMan is required. The message will be accompanied by other status line messages that will indicate the problem area.

Air exchange problem - If the air exchange valve is open, the pressure difference between the eye pressure sensor and the air exchange pump pressure sensor should be less than 15 mmHg (for low flow rate conditions the pressure difference will be close to zero mmHg). If a pressure difference of 15 mmHg or greater is detected, this message will be displayed.

Air pump problem - At power-up, a test is made of the ability of the air exchange pump to generate pressure. If pressure was not detected, this message will be displayed when the air exchange surgical function is enabled.

Shutdown at 55°C
If the internal device temperature is 53 °C or higher, but less than 55 °C, this message is displayed in the status line.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem and reports a high temperature condition, this message may be displayed. Under normal operating conditions, the internal temperature of the system won't reach this limit. Check for airflow restrictions around the system. Especially near the main system fan and the air duct at the rear of the system.

Stabilizing...
This message indicates that a hardware problem was detected while waiting for the pressure sensors to thermally stabilize. If this message is present, the VitMan will not function. If this message should appear, power cycle the device.

Stage 1 selected
When the stage button is pressed and held, if stage one will be entered when the stage button is released the message "Hold to enter stage 1" will be displayed. Releasing the stage button will cause stage one to be entered and this message to be displayed in the status line.

Stage 2 selected
When the stage button is pressed and held, if stage two will be entered when the stage button is released the message "Hold to enter stage 2" will be displayed. Releasing the stage button will cause stage two to be entered and this message to be displayed in the status line.

Stage 3 selected
When the stage button is pressed and held, if stage three will be entered when the stage button is released the message “Hold to enter stage 3” will be displayed. Releasing the stage button will cause stage three to be entered and this message to be displayed in the status line.

Stage 4 selected
When the stage button is pressed and held, if stage four will be entered when the stage button is released the message “Hold to enter stage 4” will be displayed. Releasing the stage button will cause stage four to be entered and this message to be displayed in the status line.

Stage 5 selected
When the stage button is pressed and held, if stage five will be entered when the stage button is released the message “Hold to enter stage 5” will be displayed. Releasing the stage button will cause stage five to be entered and this message to be displayed in the status line.

Stage 6 selected
When the stage button is pressed and held, if stage six will be entered when the stage button is released the message “Hold to enter stage 6” will be displayed. Releasing the stage button will cause stage six to be entered and this message to be displayed in the status line.

Stage 7 selected
When the stage button is pressed and held, if stage seven will be entered when the stage button is released the message “Hold to enter stage 7” will be displayed. Releasing the stage button will cause stage seven to be entered and this message to be displayed in the status line.

Temp sensor problem
If the temperature sensor is undetectable, this message is displayed in the status line. Powering the VitMan off and then on may clear the problem.

The temperature sensor monitors the internal temperature of the system and resides on the analog board. The temperature sensor is a serial device that provides a properly formatted response to a number of commands. If proper communication is not established, any values read are not used. If the temperature sensor has a problem, this message will be displayed.

Threshold is xx mmHg
The aspiration threshold allows the user to specify the vacuum level required in the 50cc chamber, before the aspiration valve is opened. If aspiration is prevented by the current threshold setting, this message is displayed in the status line, where “xx” is the current threshold value. The aspiration threshold may be adjusted using the “Aspiration Threshold” command, found in the “Aspiration Values” menu of the “Current Settings” menu.

Tuning aborted
If the ultrasound handpiece tuning cycle is terminated by turning off the ultrasound surgical function or by foot pedal activity, this message is displayed in the status line.

Tuning handpiece
While the ultrasound handpiece is being tuned, this message will be displayed in the status line.

Tuning not allowed
If aspiration is off or in alarm, tuning of the ultrasound handpiece is not allowed. If an attempt to tune the ultrasound handpiece is made, this message will be displayed in the status line.

Tuning unsuccessful
If the ultrasound handpiece tuning cycle is unsuccessful, this message will be displayed in the status line.

Ultrasound fuse open
The ultrasound fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the +24 volt power is not present on the ultrasound electronics. In addition to the fuse opening, this message could be caused by a problem with the +24 volt output of the power supply.

Urgent system problem
If a communications problem is detected between the CPU board and the analog board, this message will be displayed in the status line. This is a serious problem that requires attention before use. Powering the VitMan off and then on may clear the problem.

The A/D converter, present on the analog board, provides several constant values that are used to determine the quality of information and integrity of the communications path. If these values are found to be in error, this message will be displayed. The A/D converter is the primary source of information on the status of the system. The quality of the information provided is vital to the proper operation of the system.

Use locking knob only
If the cassette level detection logic determines that the aspiration cassette is not properly aligned, this message will be displayed in the status line. This generally indicates that the cassette is pushed into the cassette chamber prior to rotating the knob into the lock position. To correct the problem, rotate the knob to the unlocked position then back to the locked position without pressing on the cassette. The “Cassette position bad” and “Reposition cassette” messages will also be displayed.

Vacuum fuse problem
The vacuum pump fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

This message indicates that the vacuum pump power is not present. In addition to the fuse opening, this message could be caused by a problem with the +12 volt power.

Vacuum pump hours
The run time on the vacuum pump has exceeded the maximum limit. The pneumatics module needs to be serviced. The “Display Pump Hours” command, found in the “Service Pneumatics” menu of the “Service Menu”, can be used to display the current vacuum pump hours.

Valve fuse problem
The valve fuse on the analog board has opened. This fuse is resettable, powering the VitMan off and then on may clear the problem.

System Test Procedures

System Operation Check

The *Syntec* **VitMan** includes various subsystems that operate together to provide the functions of a vitrectomy system. This procedure confirms that the system is assembled correctly, and that no major system malfunctions exist. It does not verify calibration of the internal pressure sensors or of internal operating pressures. Various circumstances require verification of correct system operation:

- System installation
- Complaint that system isn't operating properly
- After maintenance on the system
- After upgrade of system hardware or software

In order to evaluate the system, certain items are required:

- VitMan system
- Power cord
- System foot pedal
- System owner's manual
- Aspiration cassette
- Vitrector
- Air Exchange tubing w/ air exchange filter
- Infusion cannula
- Endoilluminator
- Ultrasound handpiece (if appropriate)
- Ultrasound needle (need not be new)
- Beaker or bowl of water, at least 350cc

An assumption is made in this procedure that the operator of the system, is familiar with system operation and setup. Refer to the owner's manual for information on how to operate the system. Operation of the system's menus is required to verify system operation. The owner's manual includes comprehensive information on the operation of the menus. This procedure will refer to a specific series of menu selections separated by a \. For example **Values \ Current A/D Values** signifies selecting Values from the Main menu, then selecting Current A/D Values from the Values menu. A complete listing of the menu selections will be given from the main menu, even if a shorter route from the current screen could be taken in the menu tree. This allows the operator to access the correct menu screen without following this procedure step by step. Perform the following steps. If the system does not react as described, refer to the troubleshooting procedure for a remedy.

1. Connect the power cord and foot pedal to the system. Turn system on.
2. Install the aspiration cassette. Connect the vitrector (both pressure and aspiration tubes, route the asp. tube correctly), endoilluminator, air exchange tubing, and infusion cannula..
3. Check the system light source.
   a. Ensure that all other functions are off.
   b. Remove both lamps from the light source. Close the light source drawer. Don't touch the lamps with fingers. Use a clean cloth or gloves. Refer to the light

source lamp replacement procedure for more information.

c. Turn the light source dimming knob fully clockwise. Turn the light source on. The system display should indicate that both bulbs have failed. Turn the light source off.

d. Install a lamp in the “B” socket (right socket). Close the light source drawer. Turn the light source on. Light should radiate from the endoilluminator after a few seconds for the bulb warm-up. Turn the light source off. The system display should indicate that the “A” bulb has failed.

e. Wait approximately one minute for the lamp to cool. If the light source was turned on for more than just a few seconds it will take longer for it to cool. Remove the lamp from the “B” socket and install it in the “A” socket . (Note that the system will automatically move the lamp sockets into the “A” position when the light source drawer is opened. There could be a delay of a couple of seconds for this to happen after the drawer is opened.) Close the light source drawer. Turn the light source on. Light should radiate from the endoilluminator after a few seconds for the bulb warm-up. Turn the light source off. The system display should indicate that the “B” bulb has failed.

f. Wait approximately one minute for the lamp to cool. Install the other lamp into the “B” socket. Close the light source drawer.

g. Turn the light source on. The system display should indicate that the “A” bulb is on. It should not indicate that either lamp has failed. Observe the light radiating from the endoilluminator by projecting onto a surface from approximately 5cm. It should appear very bright white. Turn the dimming knob counterclockwise. The endoilluminator output should start to dim after some rotation of the knob. The output should stay substantially unchanged, except for intensity, through most of the rotation of the dimmer knob. Repeat this test for the other two connector outputs. (Don’t forget to turn the dimmer back up.)

h. Turn the light source off. Press and hold the light source on/off button (This will initiate a change in the illuminated lamp from A to B. Release the button after the light source output has started to radiate light then has turned off again.). Observe the light radiating from the endoilluminator by projecting onto a surface from approximately 5cm. It should appear very bright white. Turn the dimming knob counterclockwise. The endoilluminator output should start to dim after some rotation of the knob. The output should stay substantially unchanged, except for intensity, through most of the rotation of the dimmer knob. Repeat this test for the other two connector outputs.

i. Turn the light source off.

4. Check aspiration function. Note that whenever an aspiration cassette is used to aspirate fluids (especially a cassette that may have been abused, as is usually the case with test components), it is advisable to ensure that the float valve in the smaller chamber is operating correctly. Fluid should start transferring from the smaller chamber to the larger chamber when the fluid level reaches approximately half way up the float. If the fluid goes more than 3/4 up the float, then the cassette should be considered faulty. Use of a faulty cassette could result in aspiration of fluids into the system.

   a. Immerse the vitrector tip in water.

   b. Turn aspiration function on. Enter anterior aspiration mode. The status LED

should turn green.

c. Adjust the maximum aspiration to 500 (or the system max).
d. Enter into the system menu, go to **Values \ Current A/D Values.**
e. The **500cc** value should read greater than 550. The **50cc** value should read 5 maximum.
f. Depress the foot pedal until the **Pedal** value is slightly more than the activity threshold. The activity threshold default is 10%. It can be found under **Current Settings \ Pedal Thresholds \ Activity Threshold**. The irrigation pinch valve should open. Release the foot pedal. The irrigation pinch valve should close.
g. Depress the foot pedal until the **Pedal** value is slightly more than the irrigate to aspirate threshold. The irrigate to aspirate threshold default is 10%. It can be found under **Current Settings \ Pedal Thresholds \ Irrigate To Aspirate**. The aspiration pinch valve should open. Release the foot pedal. The aspiration pinch valve should close. Note that if the activity threshold is at 10% and the irrigate to aspirate threshold is at 10% then the aspiration pinch valve should open after 20%. To calculate the position that the aspiration pinch valve opens, the two thresholds are added together in anterior surgical modes . Note also that the aspiration threshold setting under **Current Settings \ Aspiration Values** can also affect the opening of the aspiration pinch valve. The default is 0 mmHg. The aspiration pinch valve will not open until the vacuum level in the 50cc (smaller) chamber of the cassette has reached the aspiration threshold setting, regardless of threshold adjustments for the foot pedal.
h. Rotate the foot pedal to activate reflux. The direction (left or right) for reflux is determined under **Current Settings \ Aspiration Values**. The reflux valve should respond based on the setting under **Current Settings \ Aspiration Values**. **Continuous Reflux** mode causes the reflux valve to remain closed for the entire time that the foot pedal is rotated. **Timed Reflux** causes the reflux valve to close (after the foot pedal is rotated) for the time determined under **Current Settings \ Aspiration Values \ Reflux Hold Time**.
i. Rapidly depress the foot pedal fully. The **50cc** value should quickly (less than 1 second) reach the maximum aspiration adjustment. It is normal for the value to over shoot up to 10 on very high maximum aspiration settings. The value should stabilize to within 2 of the maximum aspiration setting in a couple of seconds. The aspiration function should not go into alarm, as would be indicated by the status LED turning red.
j. Adjust the maximum aspiration setting to 250 (or 1/2 of system max). Repeat step 4.i.
k. Adjust the maximum aspiration setting to 50 (or 1/10 of system max). Repeat step 4.i. The value over shoot should be less than 5.
l. Return to the system operating display (By pushing the display button).
m. Adjust the maximum aspiration setting to 250 (or 1/2 of system max). Aspirate fluid into the aspiration cassette. If the cassette icon is enabled in the **Display** menu, then it should graphically indicate an increase in fluid by “filling up” as the fluid level raises in the larger chamber of the aspiration cassette. At approximately 250cc of fluid in the larger chamber of the aspiration cassette an alarm should sound (If the speaker is enabled under the **Audio Services** menu.), and

a status line message should indicate **High cassette level**. At approximately 300cc of fluid in the larger chamber of the aspiration cassette an alarm should sound, and a status line message should indicate **Cassette full**. At approximately 325cc of fluid in the larger chamber of the aspiration cassette an alarm should sound, and a status line message should indicate **Cassette over full**. Aspiration should fail to function any further until the over full cassette condition is removed.

n. Remove and empty fluid from the aspiration cassette. Replace the aspiration cassette.

5. Check vitrector function.
   a. Turn the vitrector function on. Turn the aspiration function off.
   b. Adjust the cut rate to 1000 cpm
   c. Fully depress the foot pedal. Rotate the foot pedal to activate the vitrector. The direction (left or right) for cutting is determined under **Current Settings \ Aspiration Values**, and is opposite the side reflux is set to. For example if reflux is on the left then vitrector will be on the right. Refer to the owner's manual under the description of the menu item **Current Settings \ Vitrector Values** for more information on vitrector function options. The system should be able to drive the vitrector indefinitely at 1000 cpm without going into alarm (the status LED turns red if the function goes into alarm). Observation of the cutting port on the vitrector should indicate that the internal needle is fully closing off the port as the vitrector operates.
   d. Turn the vitrector function off.
6. Check ultrasound function (if the ultrasound option is present).
   a. Turn the ultrasound function on. The status LED should turn red. The display status line should indicate **No handpiece present**.
   b. Connect the ultrasound handpiece. Install the ultrasound needle. The status LED should remain red. The display status line should now indicate **Please tune handpiece**.
   c. Tune the handpiece. The tune should be successful.
   d. Set the ultrasound power to 50%.
   e. Fully depress the foot pedal. Rotate the foot pedal to activate ultrasound. The direction (left or right) for cutting is the same as for the vitrector. Power should be applied to the ultrasound needle. Apply the ultrasound needle tip to a test surface (raw macaroni is acceptable). Noticeable needle activity should be observed against the test surface.
   f. Turn the ultrasound function off.
7. Check air exchange function.
   a. Turn the air exchange function on.
   b. Adjust the air exchange output to 100. The function should be able to maintain at least 80 with the infusion cannula open to atmosphere.
   c. Adjust the output to 50. The output should stabilize to 50 quickly. Pinch the tube connecting the infusion cannula. The output should over shoot the setting momentarily, then settle back to 50. Release the tube. The output should under shoot the setting momentarily then settle back to 50.

System Trouble Shooting Chart

Symptom:	Possible Problem:	Refer to:
	TS refers to this Trouble Shooting Manual	
	OM refers to the Syntec VitMan Owner s Manual	
Won t Power UP	Main power fuse open	TS 2.a
	Power switch not on	OM Chapter 2
	Unit not plugged in	OM Chapter 2
	Defective plug or cord	OM Chapter 2
	Defective main power supply	TS 1.a - 1.g
	Unit is too hot (internal temperature exceeds 55”C)	TS 17.a - 17.c
	Defective Internal Voltages	TS 3.a - 3.h
	Defective CPU electronics board	TS 4.a - 4.d
Fans run but there is nothing visible in the display	Contrast adjusted too light / dark	OM Chapter 3
	Power harness missing / broken between the Analog electronics board and the CPU	TS 3.a - 3.h
	Fuse F110 open (-22VDC)	TS 3.c
	Defective Analog electronics board (-22VDC DC-DC converter failure)	TS 3.b
	Analog electronics board power supply failure. (+5VDC, +12VDC, or 12VDC missing)	TS
	Defective LCD display on CPU electronics board	TS 4.a
	Defective CPU electronics board	TS 4.a - 4.b
Syntec LOGO constantly in display	CPU Analog control cable missing / not seated fully / broken	TS 4.a - 4.b
	A/D reference missing (+5VDC-X)	TS 5.a
	Defective Analog electronics board (A/D defective)	TS 6.a
	Defective CPU (Defective battery backed RAM)	There is no check for this.
All four RED status LEDs on	CPU Analog control cable missing / not seated fully / broken	TS 4.a - 4.b
	A/D reference missing (+5VDC-X)	TS 5.a
	Defective Analog electronics board (A/D defective)	TS 6.a
	Defective CPU (Defective battery backed RAM)	There is no check for this.
Main compressor does not start	Main compressor fuse open	TS 7.a - 7.b

Symptom:	Possible Problem:	Refer to:
	Power cable to Pneumatic module not plugged in / not seated fully / broken	TS 7.e
	Defective system DC power harness	TS 7.c
	Defective Analog electronics board (drive FET open)	TS 7.d
	Defective Analog CPU communication cable	TS 6.a
	Defective compressor	TS 7.d
Vacuum Pump does not start	Cassette missing / not installed correctly	TS 8.a - 8.b
	Cassette full	TS 8.b
	Power cable to Pneumatic module not plugged in / not seated fully / broken	TS 8.d - 8.g
	Fuse F101 open (check via status screen)	OM
	Defective Analog electronics board (drive FET open)	TS 8.f
	Defective Analog CPU communication cable	TS 6.a & 8.h
	Defective pump	TS 8.f
Light source does not illuminate fibers	Dimming control turned to fully dim	OM Figure 14
	Incompatible fibers	OM Figure 59
	Both bulbs are burned out / missing	TS 9.a & 9.k
	Light source not fully installed into chassis	TS 9.g
	Fibers not fully inserted into triple fiber connector	OM Figure 14
	+24VDC failure from Vicor power supply	TS 9.l
	Fuse F106 open (check via status screen)	TS 9.l
	Keyboard cable unplugged from CPU	TS 4.c
	Defective Analog electronics board (FET drive)	TS 9.l - 9.m
Vitrector Fails to cut	Vitrector mode not selected	TS 10.a - 10.b
	Vitrector mode is in alarm (RED)	TS 10.b
	Vitrector is in single cut mode	OM Chapter 2 **VITRECTOMY:** Posterior & Anterior
	Foot pedal not rotated to right (left if cut is switched) or depressed into cutting range.	OM Chapter 2 **FOOT PEDAL** CONTROLS
	Defective Vitrector	OM Chapter 4 **VITRECTOMY** CUTTER
	Tubing incorrect / pinched	OM Chapter 2 Figures 11 - 13

Symptom:	Possible Problem:	Refer to:
	Foot pedal not connected / defective	OM Chapter 2 **BACK PANEL** CONNECTIONS & CONTROLS
	Fuse F100 open / no power to valves.	TS 15.a
	Fuse F2 open / no power to pedal.	TS 11.a
	Vit valve stuck / broken wire	TS 10.a - 10.e
	Foot pedal internal cable not seated fully / broken.	TS 11.a - 11.c
	Defective Analog electronics board (FET drive)	TS 10.e
	Defective CPU electronics board (Pedal isolation)	TS 11.a - 11.c
	Defective CPU Analog control cable. (Pedal voltage not reaching Analog electronics board)	TS 6.a & 8.h
Ultrasound Fails to cut	Ultrasound function not enabled.	TS 12.a - 12.b
	Ultrasound mode is in alarm (RED)	TS 12.b
	Power set near or at zero	OM Section 2 **POSTERIOR** ULTRASOUND: LENS FRAGMENTATIO-N
	Foot pedal not rotated to right (left if cut is switched) or depressed into cutting range.	OM Chapter 2 **FOOT PEDAL** CONTROLS
	Defective handpiece	OM Chapter 4
	Defective / not fully seated / Ultrasound signal cable	TS 12.e
	Defective / not fully seated / Ultrasound control cable	TS 12.f
	Defective / not fully seated / Ultrasound power cable	TS 12.h
	Defective Ultrasound electronics board (DC-DC converter), (Serial EEPROM), (Amp, Osc, etc.)	TS 12.e - 12.h
	Defective Analog electronics board. (Failing D/A, A/D, or enable bits.	TS 12.h
	Defective CPU electronics board	TS 12.f
Aspiration Fails	Aspiration mode not enabled	OM Chapter 2 ASPIRATION
	Aspiration mode in alarm (RED)	TS 13.a
	Aspiration set to zero	OM Chapter 2 **POSTERIOR** ASPIRATION
	Foot pedal not connected / defective	OM Chapter 2 **BACK PANEL** CONNECTIONS & CONTROLS
	Fuse F2 open / no power to pedal. Check status screen.	TS 11.a
	Cassette missing / not installed correctly	OM Chapter 2 **ASPIRATION**

Symptom:	Possible Problem:	Refer to:
	Tubing incorrectly routed / kinked / plugged	OM Chapter 2 **ASPIRATION**
	Foot pedal not depressed into aspiration range	OM Chapter 2 **FOOT PEDAL** CONTROLS
	Fuse F101 open preventing vacuum pump from running. Check status screen	TS 7.c
	Air leak internal to machine	TS 13.b
	Vacuum regulator stuck / broken wire	TS 13.h
	+12VDC-A not present at pneumatics connector	TS 13.i
	Foot pedal internal cable not seated fully / broken	TS 11.a - 11.c
	Hydrophobic filter(s) filled with fluid	TS 13.g
	Defective Analog electronics board.	TS 13.i
	Defective CPU Analog Control cable	TS 6.a & 8.h
	F100 open / no power to valves. Check status screen	TS 15.a
	Defective pinch control valve / broken wire	**TS 13.e - 13.f**
	Defective pinch valve	
Air Exchange Fails	Air Exchange Function not enabled	OM Chapter 2 **AIR EXCHANGE**
	Air Exchange function is in alarm (RED)	TS 14.a
	Air Exchange set to zero	OM Chapter 2 **AIR EXCHANGE**
	Tubing kinked	OM Chapter 2 **AIR EXCHANGE**
	3-way stop valve blocking air	OM Chapter 2 **AIR EXCHANGE**
	Fuse F103 has opened. Check status screen	TS 14.e
	Defective Air exchange compressor/ broken wire	TS 14.b
	F100 open / no power to valves. Check status screen	TS 15.a
	Defective pinch control valve / broken wire	TS 14.c
	Air leak internal to machine	TS 14.e
	Defective Analog electronics board.	TS 14.b
Disk Fails	Defective diskette. (MUST be error free.)	TS 16.d - 16.e
	Write protected	TS 16.c
	Fuse F112 open. (+5VDC to floppy) Check status screen	TS 16.b
	Defective / not fully seated / control cable between floppy and CPU electronics board	TS 16.f
	Defective /not fully seated/ power cable	TS 16.f
	Defective +5VDC regulator on Analog electronics board	TS 16.a
	Defective Floppy Drive	TS 16.f

Symptom:	Possible Problem:	Refer to:
	Defective CPU	TS 16.f
Pedal Fails	Foot Pedal not plugged into unit	OM Chapter 2 **BACK PANEL** CONNECTIONS & CONTROLS
	Fuse F2 open. (+5VDC to pedal.) Check status screen.	TS 11.a
	Defective foot pedal / cable	TS 11.a - 11.c
Too Hot		TS 17.a - 17.c
Noisy		TS 18.a - 18.e

Trouble Shooting Steps

1. Main Power supply checkout

Step	Procedure	Rationale	Notes
1.a	Remove the top and bottom covers. Place the unit on its left side (with the light source high) Use a voltmeter to verify the +12VDC voltage present on the output of the main power supply with the unit powered up.	The +12VDC supply is used for the majority of the functions in the VitMan. The DC harness takes the +12VDC directly from the main power supply to the Analog electronics board where it is distributed via separate fuses to the fans, pumps, and electronics. If the +12VDC is out of specification, try disconnecting the DC harness from the Analog electronics board. This will allow isolation of the problem to either an excessive load on the power supply or a defective output. If the +12VDC is absent, check the +24VDC to see if it is present. If it too is absent, the power supply either has failed or is not receiving AC input.	The +12VDC should measure between 11.5 and 12.5 VDC.
1.b	If the +12VDC is below +11.5VDC, disconnect the main DC harness from the Analog electronics board. Measure the +12VDC again.	If the power supply is capable of supplying a correct +12VDC with the DC harness disconnected, either the main power supply has failed or there is a short in the DC harness. Use the Power Supply Removal procedure to gain access to the DC harness. Check it thoroughly for damage and either replace the harness or the main power supply.	
1.c	Measure the +24VDC voltage present on the output of the main power supply.	The +24VDC supply is rated at 200W and is used for four functions in the VitMan. It is the power source for illumination (150W), ultrasound (45W), air exchange (3W), and the internal speaker (1W). The DC harness takes the +24VDC directly to the Analog electronics board where it is distributed via separate fuses. If the +24VDC is out of specification, try disconnecting the Analog Ultrasound power cable from the Analog electronics board and/or the DC harness. This will allow isolation of the problem to either an excessive load on the power supply or a defective output.	The +24VDC should measure between 23 and 25 VDC.

Step	Procedure	Rationale	Notes
1.d	If the +24VDC is below +23VDC, disconnect the main DC harness from the Analog electronics board. Measure the +24VDC again.	If the power supply is capable of supplying a correct +24VDC with the DC harness disconnected, either the main power supply has failed or there is a short in the DC harness. Use the Power Supply Removal procedure to gain access to the DC harness. Check it thoroughly for damage and either replace the harness or the main power supply.	
1.e	Verify that input power is present at the out put terminals of the power entry module by carefully releasing the rear panel and measure the voltage across the power entry terminals with the unit turned on. This voltage should match the line input.	There are several internal connections in the power entry module. It is unlikely there will be an internal open but a check of the voltage present on the output terminals will verify no power entry problem exists.	
1.f	Perform this step ONLY if there is no +12VDC and no +24VDC from the system power supply with the DC power harness disconnected from the Analog electronics board. Use an AC voltmeter to verify that AC is correctly connected to the power supply. This will require that the power supply assembly be removed.	There is a power line filter in the AC path between the power entry fuse / switch and the power supply. The check of power present at the input terminals of the power supply will verify that there is no open wire or open in the power line filter. The power supply requires either 100 120 VAC or 200 240 VAC 50 / 60 Hz. AC voltages outside these ranges are not specified to work.	The AC at the power supply input terminals should match the known AC line.

Step	Procedure	Rationale	Notes
1.g	If both +12VDC and +24VDC are present, verify that all voltages are reaching the Analog electronics board by disconnecting the power harness from the Analog electronics board and verifying the voltages present.		The pin assignment is listed in Appendix A: Analog Vicor Power Cable.

2. Main fuse check

Step	Procedure	Rationale	Notes
2.a	Pry open the fuse cover and check the fuse.	The most likely cause of a system not running will be the main entry fuse. This fuse can blow on excessive inrush current or having the unit fused for 250VAC operation (6.3A) and then running the system on 120VAC (10A needed).	

3. Internal DC Voltage Check

Step	Procedure	Rationale	Notes
3.a	Remove the top and bottom covers. Disconnect the power cable running between the Ultrasound and the Analog electronics board. Carefully measure all voltages to verify they are present.	The DC-DC converter generates +12VDC-A, -12VDC-A, and +5VDC for use on the CPU, Analog, and Ultrasound electronics boards. All three of these voltages are present on the Analog Ultrasound power cable.	The connector pin assignments are listed in Appendix A: Analog Ultrasound Power Cable.
3.b	Disconnect the power cable running between the CPU and the Analog electronics board. Carefully measure the 22VDC to verify that it is present on the Analog electronics board terminal.	An additional DC-DC converter creates the 22VDC needed to provide bias to the LCD display. If this supply is missing, the display will be blank. This supply is connected to the CPU via pin 7 of the power cable. If the 22VDC is not present the Analog electronics board is defective.	

Step	Procedure	Rationale	Notes
3.c	Reconnect the power cable and verify the all voltages are present at the CPU electronics board. Measure the voltages on the opposite side of the CPU from the connector. For reference, the wires colors have the following meaning: Black: Ground Red: +5VDC Violet: +12VDC Grey: -12VDC Yellow: -22VDC	Failure of one of the voltages is likely due to a broken wire in the power harness since the supply fuses were indirectly checked in step 3.a . If the 22VDC is now missing when it was present in step 3.b , there is either a problem with a broken yellow wire or the CPU electronics board is loading down the supply.	The 22VDC is the only voltage which was not tested present on the Analog Ultrasound connector when the Analog CPU cable was present. Fuse F110 on the Analog electronics board will open is there is a short on the 22VDC on the CPU electronics board. This fuse is resettable and will reset when power is removed.
3.d	If the 22VDC is missing, carefully remove the power harness connector from the CPU electronics board and measure between the yellow and black wires.	This check should determine if the 22VDC exists at the CPU end of the cable. If the 22VDC is present, the CPU is defective	A second possibility could be a failure in the 22VDC supply on the Analog electronics board. If the problem is not resolved by changing the CPU electronics board, the Analog electronics board is defective.
3.e	Check for the presence of +12VDC on the both sides of F113.	If the +12VDC-A, -12VDC-A, or +5VDC are missing it is possible a fuse has blown. Use a voltmeter to check for the presence of +12VDC on the source side of the DC-DC converter fuse F113. An open on this fuse would indicate a defective Analog electronics board.	
3.f	If +12VDC is missing, there may be a problem in the power harness.	+12VDC is taken from the main power supply and routed to the Analog electronics board along 3 separate paths. +12VDC is supplied to the main compressor and vacuum pump via pins 7 & 8 of the JP104 connector. +12VDC is supplied as a source to the control valves via JP104 pin 2. The remaining +12VDC loads, including the DC-DC converter that drives power for the CPU, are supplied via JP104 pin 1.	

Step	Procedure	Rationale	Notes
3.g	Check for the presence of +12VDC-A, -12VDC-A and +5VDC on both sides of fuses F107, F108, and F111	There are also three fuses on the output side of the DC-DC converter. An open in one of these fuses would indicate a problem with the Analog electronics board when both the Analog - Ultrasound power cable and the Analog CPU power cable are disconnected.	
3.h	Check for +12VDC present on both sides of fuse F105	The 22VDC DC DC converter runs from the +12VDC main supply via fuse F105. F105 also supplies power to the floppy disk linear regulator (U154) and drives the three Opto-isolators ISO101 ISO 103. All of these loads are on the Analog electronics board. A failure in the +12VDC main would indicate a defective Analog electronics board.	

4. CPU electronics board check

Step	Procedure	Rationale	Notes
4.a	Remove the top and bottom covers. Check the power entering the CPU via the Analog CPU power cable. This includes the 22 VDC.	An intermittent power cable wire may be the culprit in a nonfunctioning CPU. A check of the power at the CPU pins will guarantee that the power is present. If there are no characters in the LCD display while +5VDC, +12VDC-A and 22VDC are present, the CPU electronics board is defective.	The failure may actually be on the LCD module attached to the CPU electronics board. Also try adjusting the contrast by depressing the right blue button to make the display lighter or the left blue button to make the display darker.

Step	Procedure	Rationale	Notes
4.b	Check for full seating / damage on the CPU Analog control cable.	If the Syntec Logo is on the display constantly and the four LEDs are RED, there may be a problem in communications between the CPU and the Analog electronics boards. The CPU Analog signal cable connects the Analog A/D converter to the CPU on pins 42, 44, 46, 48, and 50. If the CPU can not communicate with the A/D on the Analog electronics board, it will remain in the Syntec Logo state.If the cable is intact, the problem can be on the CPU or the Analog electronics boards. The Analog electronics board could have a defective A/D or the CPU could be failing to access the A/D correctly. In this case, assume the Analog electronics board is defective. (Since the CPU must be working fairly well to load the Syntec logo onto the display.)	On power-up the microprocessor should turn off all four front panel LEDs and then display the Syntec logo while diagnostics are run. If communications are not established between the CPU and Analog electronics board, the run-time code has a bad checksum, or the 10ms interrupt is missing from the real time clock (U16), the LEDs are set to RED. (The run-time code and the real time clock are both located on the CPU electronics board.)
4.c	Check that the keyboard pigtail cable is fully seated on the CPU electronics board connector.	Failure of the system to respond to the keyboard could be to a problem with the keyboard signal cable. If no problem is found, the CPU electronics board is most likely defective.	This assumes that the system comes up with its normal initial screen. With no keyboard functions operating.

Step	Procedure	Rationale	Notes
4.d	Check the foot pedal connection to the CPU electronics board.	The foot pedal is powered with +5VDC via fuse F2. The foot pedal position is returned from the foot pedal via a 2.5K pot installed in the foot pedal. ~0VDC is returned when the pedal is up and ~5VDC is returned when it is fully down. In addition, three microswitches are tied to supply ~5VDC when in the inactive state and ~0VDC when active. These three switches indicate the pedal is up, right, or left.	The signals are passed across an optoisolator electronics board which is mounted on the rear of the CPU electronics board. A failure of one of the optoisolators will prevent the footpedal from operating correctly. The operation of the footpedal is displayed in the CALIBRATE FOOT PEDAL menu. This screen indicates the state of the three switches and has a bar graph to indicate the footpedal position.

5. A/D Reference check

Step	Procedure	Rationale	Notes
5.a	Remove the top and bottom covers. Use a DVM to measure the +5VDC on the Analog electronics board between TP101 (Gnd) and X100 pin 4	The A/D on the Analog electronics board needs a +5VDC (– 5%) reference to operate properly. The A/D reference is also fed to all five pressure sensors. absence of +5VDC when +12VDC is present on both sides of fuse F111 indicates a failure in the +5VDC linear regulator or a shorted component. I.e. the Analog electronics board is defective.	The CPU will hang at the Syntec Logo if the A/D fails to report correct codes due to a defective +5VDC reference at the A/D.

6. Analog electronics board check

Step	Procedure	Rationale	Notes
6.a	Perform a EEPROM read from the Analog electronics board using the READ ANALOG BOARD submenu in the SERVICE MENU. If this read fails, perform a EEPROM read from the Ultrasound electronics board utilizing the read ultrasound board command.	This action verifies that the microprocessor can communicate on the central portion of the CPU to Analog electronics board control cable. If both reads fail, either the CPU electronics board has failed or the Analog to CPU electronics board control cable is defective. If both reads are successful, the Analog to CPU electronics board control cable is OK. A failure of only one of the two boards indicates the failing module is defective and must be replaced.	If the EEPROM fails the message Serial EEPROM failure will be displayed.
6.b	Install an empty cassette and verify that the Cassette Level icon indicates the cassette is empty.	The cassette level LEDs must be functioning properly to aspiration to function correctly.	
6.c	Connect a tubing set to the aspiration luer connector on the cassette. Enable aspiration and use the foot pedal to draw water into the cassette. Watch the cassette level icon and verify that it indicates the filling of the cassette.	The cassette level LEDs must be functioning properly to aspiration to function correctly.	

7. Main compressor check

Step	Procedure	Rationale	Notes
7.a	Verify that the main compressor and vacuum pump are enabled to run in the status screen..	Neither the main compressor nor the vacuum pump will run if disabled in the software. It is unlikely that the software has turned them off but it is worth the check	(The very action of getting to the status screen implies that the +12VDC main power supply is functioning since the CPU power is derived from one of the +12VDC connections). This screen is in the service Menu under the **TURN ON** PUMPS/TURN OFF PUMPS submenu
7.b	Remove the top and bottom covers. Use a DVM to verify +12VDC (– 10%) is present between the lower fuse clip of fuse F102 and TP100 (Gnd).	This is the load side of the fuse and should have +12VDC present at all times. If +12VDC is absent, verify that the fuse is open by removing and testing with a DMV. A good fuse that has an absent +12VDC would indicate a problem with the +12VDC connection between the main power supply and the Analog electronics board.	A blown fuse will almost certainly indicate a problem in the pneumatics module. Either there is a short in the wiring or the main compressor has stalled / shorted. As a first try, however, replace the fuse just in case a defective fuse caused the failure.
7.c	If +12VDC is absent on the lower F102 fuse clip and the fuse is good, disconnect the main power harness between the main power supply and the Analog electronics board. Use a DVM to verify +12VDC is present between pins 7 / 8 (+12VDC) and 9 (Gnd) of JP104.	+12VDC is taken from the main power supply and routed to the Analog electronics board along 3 separate paths. +12VDC is supplied to the main compressor and vacuum pump via pins 7 & 8 of the JP104 connector. +12VDC is supplied as a source to the control valves via JP104 pin 2. The remaining +12VDC loads, including the DC-DC converter that drives power for the CPU, are supplied via JP104 pin 1.	Look for physical damage to the pins. A defective harness could cause arcing inside the connector and lead to failure of the wires.

Step	Procedure	Rationale	Notes
7.d	If +12VDC is present on the lower F102 fuse clip, check the pump return by CAREFULLY using a DVM to measure between the exposed metal tab of Q101 and TP100 (Gnd). This voltage should be near zero.	The tab of Q101 is near 0VDC and the pumps not running implies there is either an open in the main compressor wiring or the compressor has seized. If +12VDC is present on Q101, the Analog electronics board is defective.	The open could also be a defective connector pin. (Either on the Analog electronics board or in the pneumatic power harness.)
7.e	If step 7.d indicates a near zero voltage, remove plug P103 from the Analog electronics board and inspect the pins and wires.	A defective (arcing) pin could cause damage to the Analog electronics board, in addition, to causing a failure in the pneumatics power harness. Replace the pneumatics module if there is damage to the harness or pins. Replace the Analog electronics board if there is damage to the PCB mounted connector.	
7.f	Run the calibration routine for the Air Exchange	Run this procedure to verify that the entire data bus is operating between the CPU electronics board and the Analog electronics board. The Air Exchange calibration routine utilizes same address and data bus signals to operate the Air Exchange as are needed to enable the Main Compressor.	A very remote possibility would be a communication problem between the CPU and Analog electronics boards. This is VERY unlikely.

8. Vacuum pump check

Step	Procedure	Rationale	Notes
8.a	Verify that the main compressor and vacuum pump are enabled to run in the status screen	Neither the main compressor nor the vacuum pump will run if disabled in the software. It is unlikely that the software has turned them off but it is worth the check.	The very action of getting to the status screen implies that the +12VDC main power supply is functioning since the CPU power is derived from one of the +12VDC connections). This screen is in the service Menu under the **TURN ON PUMPS/TURN OFF PUMPS** submenu

Step	Procedure	Rationale	Notes
8.b	Install an empty cassette and verify that none of the following messages are displayed: **Cassette over full** No cassette present Re-position cassette	These messages indicate that the CPU has determined the cassette is not in the correct position to enable the vacuum pump.	here is a column of infrared LEDs on the Analog electronics board which are aimed at a prism on the cassette. Normally this column of LEDs is used to detect the level of fluid in the cassette and the full and over full conditions. If the cassette is positioned incorrectly, the CPU will not enable the pump to run.
8.c	Check that the vacuum pump fuse is OK in the fuse status screen	A blown fuse will almost certainly indicate a problem in the pneumatics module. Either there is a short in the wiring or the vacuum pump has stalled / shorted. The fuse status screen is in the service menu under the analog device fuses submenu.	The vacuum pump fuse is an automatic resetting fuse and is not replaceable. The fuse resets itself when power is disconnected from it. The fuse failure circuit utilizes the presence of the +12VDC as the indication of no fuse failure. A failed connection to the main power supply will give a failed fuse indication.
8.d	Remove the top and bottom covers. Disconnect the pneumatic power cable. Use a DVM to verify +12VDC (–10%) is present between pin 3 of JP103 and TP100 (Gnd).	This is the load side of the fuse and should have +12VDC present at all times. +12VDC absent indicates a problem with the +12VDC connection between the main power supply and the Analog electronics board.	

Step	Procedure	Rationale	Notes
8.e	If +12VDC is absent with JP103 disconnected, try disconnecting the main power harness between the main power supply and the Analog electronics board. Use a DVM to verify +12VDC is present between pins 7 / 8 (+12VDC) and 9 (Gnd) of JP104.	+12VDC is taken from the main power supply and routed to the Analog electronics board along 3 separate paths. +12VDC is supplied to the main compressor and vacuum pump via pins 7 & 8 of the JP104 connector. +12VDC is supplied as a source to the control valves via JP104 pin 2. The remaining +12VDC loads, including the DC-DC converter that drives power for the CPU, are supplied via JP104 pin 1.	Look for physical damage to the pins. A defective harness could cause arcing inside the connector and lead to failure of the wires.
8.f	If +12VDC is present on JP103, reconnect the pneumatic power harness. Check the pump return by CAREFULLY using a DVM to measure between the exposed metal tab of Q105 and TP100 (Gnd). This voltage should be near zero.	The tab of Q105 is near 0VDC and the pump not running implies there is either an open in the vacuum pump wiring or the compressor has seized. If +12VDC is present on Q105, the Analog electronics board is defective.	The open could also be a defective connector pin. (Either on the Analog electronics board or in the pneumatic power harness.)
8.g	If step 8.f indicates a near zero voltage, remove plug P103 from the Analog electronics board and inspect the pins and wires.	A defective (arcing) pin could cause damage to the Analog electronics board, in addition, to causing a failure in the pneumatics power harness. Replace the pneumatics module if there is damage to the harness or pins. Replace the Analog electronics board if there is damage to the PCB mounted connector.	
8.h	Run the calibration routine for the Air Exchange	Run this procedure to verify that the entire data bus is operating between the CPU electronics board and the Analog electronics board. The Air Exchange calibration routine utilizes same address and data bus signals to operate the Air Exchange as are needed to enable the Vacuum Pump.	A very remote possibility would be a communication problem between the CPU and Analog electronics boards. This is VERY unlikely.

9. Light source check

Step	Procedure	Rationale	Notes
9.a	Verify that the light source lights up when the function is turned on	There are two differing paths depending on whether the bulbs are lighting up. A) If there is light, then the problem is in the optic path. (Light bulb out of alignment, dimming mechanism, fiber shutters, etc.) {Use steps 9.c 9.f } B) If there is no light, then the problem is electrical. {Use steps 9.h 9.m }	There is one blended failure possibility. The light source tray uses air pressure to move the A and B bulbs into position. If the two air lines were crossed during a repair, or the individual light source connectors on the Analog electronics board were crossed during a repair, the bulb in the backup position will light but will fail to light the fibers since it will not be in the optic path.
9.b	Check the intensity control knob on the front of the light source. If the intensity is set at maximum and the illumination output is not adequate, check the fiber optic cable for kinks. If all other indications are normal, replace the fiber optic endoilluminator.		
9.c	Verify that the correct bulb is in the optic path by opening the light source drawer with illumination on. The glowing bulb should be in front of the mirror as the drawer is opens.	A failure in the bulb switching mechanism could leave the bulb is a state where the incorrect bulb is illuminated. This can be caused by an air leak in the bulb exchange mechanism or by failure on the bulb exchange valves.	The control software will always slide the bulbs to the left as the drawer is opened. It is important to identify that the correct lamp was lit as the drawer is first opened.

Step	Procedure	Rationale	Notes
9.d	If the incorrect bulb is illuminated, make sure that both bulbs are good and re-install the light source drawer into the unit. Remove the top and bottom covers. Turn on illumination and then use the illumination ON/OFF button to select the B bulb. Verify that both bulb control valves have their LEDs lit.	The light position slide is controlled by a pair of valves on the pneumatic module Both valves should be energized to force the backup mechanism to point to the B bulb.	
9.e	If the both valve LEDs do not illuminate, turn the system on its side and disconnect the pneumatics control cable. Measure the resistance between pins 15 and 16. It should measure ~ 250 ohms. Measure the resistance between pins 17 and 18. It should also measure ~ 250 ohms	An open in either circuit indicates a defective pneumatics module. If both circuits are good, the Analog electronics board is defective.	
9.f	If the correct bulb is in the optics path, carefully open the light source drawer and inspect the optics path.	Both lenses, the infra-red filter, and the spherical mirror should be held firmly in place with their retaining rings. In addition, the dimming mechanism should rotate freely. Inspect the shutter mechanism to make sure it has not broken loose from its cemented location. If any problem is found in the optics path, replace the optics drawer.	
9.g	Make certain the optics drawer is fully installed into the system.	The optics drawer is held in position with a rotating latch (See OM Figure 14). A failure to have the drawer fully installed will result in a failure to connect power to the bulbs.	

Step	Procedure	Rationale	Notes
9.h	Verify that the light source illuminated Icon is in the LCB display.	The unit will display the illumination Icon when the Analog electronics board is commanded to turn the lamp on. If the Icon does not appear, there may be a problem in recognizing the illumination button. Check that other surgical functions can be activated to isolate to a specific button that has a failure. If a single button has a failure, the keyboard is defective.	
9.i	If illumination appears to not function properly, check the console display for warning messages.	Replace the bulb(s) if necessary. Be very careful that the bulb is not hot before it is removed. Do not touch the bulb with bare fingers.	
9.j	If all buttons fail, check that the keyboard interface cable is fully seated onto the mating pins of the CPU electronics board.	A correctly seated connection between the keyboard and the CPU would indicate the failure is in the CPU electronics board.	

Step	Procedure	Rationale	Notes
9.k	Verify that none of the following messages are in the LCD status line: **1) Bulb A missing** 2) Bulb B missing 3) Bulb A failure 4) Bulb B failure 5) Bulb fuse failure	The bulb X missing message indicates that the system does not see the specified bulb. It may be burned out, or there is a break in the +24VDC path through the bulb(s) and back to the Analog electronics board. The bulbs are supplied with +24VDC from the main power supply via fuse F106. The condition of F106 is sensed and will display a bulb fuse failure if it is open. F106 is a resettable fuse. It will reset itself when power is removed. As a result, a bulb fuse failure most likely indicates a short in one of the bulb supply cables or a short inside the Light Source Drawer. Release the Light Source Drawer and pull it partway out of the unit. If the Bulb fuse failure message stops, there is a short in one of the wires leading to the lamp sockets. If the Bulb fuse failure message persists, the pneumatics module will need to be removed so that the ORANGE +24VDC source wires can be inspected as they leave the Analog electronics board and are routed to the back side of the Light Source Drawer. The bulb X failure message indicates the system is not driving the bulbs return fully to ground. This message class indicates a failure on the Analog electronics board. If either message 1) or 2) persists after the bulb has been replaced with a known good bulb, there is likely a broken wire / unseated cable between the Analog electronics board and the Light Source Drawer. The A bulb is connected to the Analog electronics board through connector JP107. The B bulb is connected via connector JP106. Both bulbs share a common 4-pin connector at the rear of the Light Source Drawer.	The bulb fuse failure condition can occur during normal operation if a bulb were to short out internally as it fails. The short will trip fuse F106. The system will switch to the backup bulb, however, and will restore illumination as soon as F106 has recovered.

Step	Procedure	Rationale	Notes
9.l	Verify that all three of the following messages are in not in the LCD status line: **1) Bulb fuse failure** 2) Air pump fuse failure 3) Ultrasound fuse open	The main power supply delivers +24VDC through three different fuses. All three fuses indicating open is most likely a failure in the +24VDC main supply or the cable harness between the main power supply and the Analog electronics board.	The bulb fuse failure condition can occur Check for the presence of +24VDC at the main power supply. If it is present at the power supply, check for a broken wire / connection in the main DC power harness. The +24VDC is connected to pin 3 via an ORANGE wire.
9.m	Verify that neither of the following messages are displayed: **1) Bulb A problem** 2) Bulb B problem	The bulb is turned on in a two-stage process. The first stage warms the bulb by using a series 5W resistor. This will cause the bulb to glow. The second stage lights the bulb fully by shorting out the 5W resistor. A failure to light the bulb fully indicates a failure in the Analog electronics board.	

10. Vitrector check

Step	Procedure	Rationale	Notes
10.a	Verify that the Ultrasound function is NOT enabled.	The Ultrasound function is mutually exclusive with the vitrector. If the Ultrasound LED is illuminated (red of green), the Ultrasound function is selected. The Ultrasound ON/OFF button must be depressed multiple times until the LED is extinguished.	Each depression of the Ultrasound ON/OFF button cycles through the operational modes of the ultrasound handpiece. The last mode is off .

Step	Procedure	Rationale	Notes
10.b	Verify that the vitrector function is enabled on the unit and that the vitrector LED is green.	Several internal checks are made by the system. If an error exists, the vitrector function will be disabled and the LED will be red. If the internal checks are OK, the vitrector status LED will be green. Suspect the keyboard if the vitrector LED will not light and there is no keyclick from depressing the key. (The keyclick could be disabled in the Audio Services submenu) Suspect the CPU if the display indicates that the vitrector mode has been entered but the LED is still extinguished.	The intensity of the LEDs is controlled in the LED INTENSITY submenu of the DISPLAY menu. Make sure that the intensity is up fully to see the status of the LEDs in a brightly lit room. Seven internal errors can keep the vitrector from operating. If the vitrector LED is RED, check for one of the following messages: **1) Device disabled** 2) Drive fuse failure 3) Drive sevnsor failure 4) High drive pressure 5) Low drive pressure 6) No foot pedal present 7) Valve fuse failure
10.c	Disconnect the vitrector from the front panel luer connector and depress the footpedal. Check that air pulses are output from the vitrector connector.	A vitrector malfunction could occur in the pneumatic path or be electrical. If there are air pulses present, the most likely problems would be a defective vitrector or an incorrectly adjusted pressure regulator on the pneumatics module. A remote possibility would be an incorrectly connected tube between the pneumatic module and the system.	If there are no air pulses, listen for the operation of the vitrector valve and observe the operation of the vitrector valve LED
10.d	If there are no air pulses, remove the top and bottom covers. Listen for the operation of the vitrector valve, and observe the operation of the vitrector valve LED.	Each valve has an accompanying red LED that is illuminated when the valve is activated. In the case of the vitrector valve, the valve is activated to place a pressure pulse out the vitrector connector. If the valve LED is flashing but air is absent, there is most likely a obstruction in the air path, the pressure regulator for the vitrector has failed, or the vitrector valve is receiving power but failing to operate. Any of these require that the pneumatics module be replaced.	If the valve LED does not illuminate, there may be a broken wire / not fully seated connector / between the pneumatics module and the Analog electronics board.

Step	Procedure	Rationale	Notes
10.e	If the valve LED does not illuminate, turn the system on its side and disconnect the pneumatics control cable. Measure the resistance between pins 5 and 6. It should measure ~ 250 ohms.	There may be a broken wire / not fully seated connector / between the pneumatics module and the Analog electronics board. If the resistance indicates an open circuit, there is either a break in the valve cable, or the valve is defective. In either case, the pneumatics module is defective. If the circuit indicates it is closed, there is likely a problem with the drive electronics. The Analog electronics board should be replaced.	The vitrector valve is connected to pins 5 & 6 of the control cable.
10.f	If the vitrector function LED is green, verify that the footpedal is commanding the vitrector to cut. If the guillotine icon does not appear, see problem in the footpedal interface .	The display will show a guillotine icon when the footpedal is rotated to the enable cutting position. This is normally the right position of the pedal. (The guillotine icon could be disabled from the CUTTER ICON IS ON/CUTTER ICON IS OFF submenu.)	The cut position can be switched to the left with the REFLUX IS ON LEFT/REFLUX IS ON RIGHT menu command.

11. Foot pedal interface check

Step	Procedure	Rationale	Notes
11.a	Use a DVM to measure the voltages between pin 1 and pins 2, 4, 5, 7, 9, and 10 of P1 on the optoisolator babyboard. 1) Pin 2 should be at ~5VDC. 2) Pin 4 should be at ~0VDC when the pedal is connected. 3) Pin 7 should be at ~0VDC when the pedal is moved right and at ~5VDC otherwise. 4) Pin 7 should be a ~0VDC when the pedal is moved left and at ~5VDC otherwise. 5) Pin 9 should be at ~5VDC when the pedal is up and at ~0VDC otherwise. 6) Pin 10 should be at ~0VDC when the pedal is up and ~5VDC when it is fully depressed.	The footpedal contains three switches that are active when the pedal is moved from its idle position. A failure in the footpedal or its cable could prevent the signal from reaching the CPU electronics board. In addition, the footpedal control cable routes the signals inside the system from the rear panel connector to the CPU electronics board. A broken wire / not fully seated / connector could cause the problem. A failure in any of these voltages indicates a problem in the footpedal	A failure on the footpedal fuse will also keep the switches from being detected. An open fuse will result in a Pedal fuse failure indication in the display

Step	Procedure	Rationale	Notes
11.b	Remove the top and bottom covers. Disconnect the footpedal and use a voltmeter to verify connectivity of the inter footpedal control cable by performing the following tests at the rear panel foot pedal connector: ~+5VDC is present on between pins 2 and 1.	A short in the footpedal or the footpedal cable can blow the resettable footpedal fuse. If the Pedal fuse failure clears when the footpedal is disconnected, the footpedal is defective	Pin 2 (+5VDC) from the optoisolator electronics board is routed to pin 2 in the footpedal connector. Pin 1 (Ground) from the optoisolator electronics board is routed to pin 1 in the footpedal connector.
11.c	Disconnect the internal footpedal control cable from the optoisolator electronics board. Use a DVM to measure the resistance between the inline connector pins 1, 2, 4, 5, 7, 9, 10 and the rear panel connector pins 1, 2, 3, 4, 5, 6, 7	A break in any one of the six conductors indicates a failure in the Cable Assy, VitMan, Foot Pedal Internal PN 1000564A.	

12. Ultrasound check

Step	Procedure	Rationale	Notes
12.a	Verify that the Vitrector function is NOT enabled.	he Vitrector function is mutually exclusive with the Ultrasound. If the Vitrector LED is illuminated (red of green), the vitrector function is selected. The Vitrector ON/OFF button must be depressed multiple times until the LED is extinguished.	Each depression of the vitrector ON/OFF button cycles through the operational modes of the vitrector. The last mode is off .

Step	Procedure	Rationale	Notes
12.b	Verify that the Ultrasound function is enabled on the unit and that the Ultrasound Ultrasound LED is green.	Several internal checks are made by the system. If an error exists, the Ultrasound function will be disabled and the LED will be red. If the internal checks are OK, the Ultrasound status LED will be green. Suspect the keyboard if the Ultrasound LED will not light and there is no keyclick from depressing the key. (The keyclick could be disabled in the Audio Services submenu) Suspect the CPU if the display indicates that the Ultrasound mode has been entered but the LED is still extinguished.	The intensity of the LEDs is controlled in the LED INTENSITY submenu of the DISPLAY menu. Make sure that the intensity is up fully to see the status of the LEDs in a brightly lit room. Ninteen internal errors can keep the Ultrasound from operating. If the Ultrasound LED is RED, check for one of the following messages: **1) Cassette over full** 2) Cassette position bad 3) Cassette valve failure 4) Device disabled 5) Drive fuse failure 6) High vacuum level 7) No Cassette present 8) No foot pedal present 9) No handpiece present 10) Please lock cassette 11) Please tune handpiece 12) Re-position cassette 13) Tuning aborted! 14) Tuning failed! 15) Tuning handpiece 16) Tuning not allowed 17) Ultrasound fuse open 18) Use locking knob only 19) Vacuum fuse failure 20) Valve fuse failure
12.c	If the Ultrasound function LED is green, verify that the footpedal is commanding the Ultrasound to cut. If the wave icon does not appear, see 11. Footpedal Interface Check	The display will show a wave icon when the footpedal is rotated to the enable cutting position. This is normally the right position of the pedal. (The wave icon could be disabled from the CUTTER ICON IS ON/CUTTER ICON IS OFF submenu.)	The cut position can be switched to the left with the REFLUX IS ON LEFT/REFLUX IS ON RIGHT menu command.
12.d	If the wave icon does appear, check the power percentage in the display. The power delivered is adjustable from 1% to 100% in 1% increments with 100% being fully on	A 1% power level may be too small to perform any noticeable cutting.	Make sure to have the ultrasound primed when performing tests with the ultrasound handpiece. The handpiece will become quite warm when there is no flow of aspirant through the handle.

Step	Procedure	Rationale	Notes
12.e	Verify that the Ultrasound interconnect cable is firmly connected to the ultrasound electronics board.	The internal cable which supplies ultrasound power to the front panel connector is routed under the system power supply and onto two connectors on the ultrasound electronics board. The connector in the upper right supplies the energy. The connector just below senses the handpiece.	Check for abrasions on the cable. It is VERY important that no damage occur to this cable.
12.f	If the handpiece is not detected, verify that the ultrasound control cable which runs between the analog electronics board and the ultrasound electronics board is fully seated at both ends and that there is no damage to the cable.	The handpiece is ultimately sensed as present at the CPU electronics board. A broken signal in either cable will prevent the correct sensing of the handpiece.	An unlikely possibility is that the failure to sense the handpiece as present is a defective CPU electronics board.
12.g	If the handpiece is detected but will not tune, check for the Ultrasound fuse status message.	If the Ultrasound fuse message is present, the ultrasound electronics board is defective.	Make sure there is no damage to the Analog Ultrasound Power cable before replacing the ultrasound electronics board.
12.h	If the handpiece is detected but will not tune, check the power delivered to the ultrasound electronics board. Release the rear panel and carefully disconnect the power harness from the ultrasound electronics board. Use a DVM to measure that the voltages are correct per the Analog Ultrasound Power Cable pinout.	The ultrasound electronics board is functionally separate from the Analog and PCB electronics boards. If there is a failure in the ultrasound electronics, the failure will not keep the remaining functions from operating. If the power cable has the correct voltages, the following items could be causing the problem: 1. The ultrasound handpiece is defective 2. The ultrasound electronics board is defective 3. The analog electronics board is defective.	The wire insulation colors have been chosen to have the following meaning: Black: Ground Red: +5VDC Violet +12VDC Grey: -12VDC Orange: +24VDC

13. Aspiration check

Step	Procedure	Rationale	Notes
13.a	Install a cassette and verify that the Aspiration function is enabled on the unit and that the Aspiration LED is green.	Several internal checks are made by the system. If an error exists, the Aspiration function will be disabled and the LED will be red. If the internal checks are OK, the Aspiration status LED will be green. Suspect the keyboard if the Aspiration LED will not light and there is no keyclick from depressing the key. (The keyclick could be disabled in the Audio Services submenu) Suspect the CPU if the display indicates that the Aspiration mode has been entered but the LED is still extinguished.	The intensity of the LEDs is controlled in the LED INTENSITY submenu of the DISPLAY menu. Make sure that the intensity is up fully to see the status of the LEDs in a brightly lit room. Twenty internal errors can keep the Aspiration from operating. If the Aspiration LED is RED, check for one or more of the following messages: **1) 500cc sensor failure** 2) 50cc sensor failure 3) Cassette Full 4) cassette over full 5) Cassette position bad 6) Cassette valve failure 7) Device disabled 8) Foot pedal problem 9) Drive fuse failure 10) High vacuum level 11) Low drive pressure 12) Low vacuum level 13) No Cassette present 14) No foot pedal present 15) Pedal fuse failure 16) Please lock cassette 17) Re-position cassette 18) Use locking knob only 19) Vacuum fuse failure 20) Valve fuse failure
13.b	If the Aspiration LED is green until the footpedal is depressed, there is likely an air leak associated with the operation of the aspiration function. Remove the top and bottom covers. Inspect the tubing connected to the vacuum sensors of the Analog electronics board. Also inspect the tubing going to the vacuum regulator and the large hydrophobic filter.	The vacuum system can not tolerate leaks to atmosphere. Any leak will have adverse effects on the aspiration function.	The inspection should be very thorough where the tubing passes near the vacuum pump. This pump can move on its mounts and can cause abrasion against the tubing.

Step	Procedure	Rationale	Notes
13.c	If the Aspiration LED is green, check that the aspiration setting is set to a value other than zero and that the aspiration pinch valve opens when the footpedal is fully depressed.	The aspiration is adjustable from 0 to 500mmHg in 5mmHg increments. The position of the system relative to the patient also effects aspiration. Ideally, the system will be placed at the same height as the irrigation bottle. If the system is located higher than the bottle, it is possible to get passive reflux. I.e. when the pedal is up to the point that the aspiration is near 0mmHg, gravity will cause reverse flow until the pedal is raised high enough to close the aspiration pinch valve. If the system is located lower than the bottle, it is possible to get passive aspiration. I.e. when the pedal is up to the point that the aspiration is near 0mmHg, gravity will continue to cause flow until the pedal is raised high enough to close the aspiration pinch valve	Aspiration is controlled by the footpedal position. The aspiration level is linear from 0mmHg to the maximum setting selected in the following modes: Posterior Aspiration Posterior Vitrectomy Posterior Ultrasound Anterior Aspiration Anterior Vitrectomy Anterior Ultrasound
13.d	If the aspiration pinch valve fails to open, check the setting of the ASPIRATION THRESHOLD in the current settings menu	The aspiration threshold specifies the minimum vacuum level which must be present before the aspiration pinch valve will be commanded to open. If this value is set too high, the valve will never be commanded to open.	See the Syntec Owner s Manuel Appendix C.
13.e	If the setting of the ASPIRATION THRESHOLD is valid, remove the top and bottom covers. Check for the correct operation of the aspiration pinch valve s control valve by observing the LED on the control valve. This LED should be lit when the pinch valve should be open.	The LED indicates that power is being applied to the valve. The aspiration pinch valve is operated by air pressure from the pneumatics module. The air is supplied through the control valve. The pinch valve is driven closed when there is no air pressure present and is opened by supplying air through the control valve.	A failure of the LED to light can indicate a broken wire in the pneumatic control cable, a defective valve, or a problem with the Analog electronics board.

Step	Procedure	Rationale	Notes
13.f	If the valve LED does not illuminate, turn the system on its side and disconnect the pneumatics control cable. Measure the resistance between pins 7 and 8. It should measure ~ 125 ohms.	There may be a broken wire / not fully seated connector / between the pneumatics module and the Analog electronics board. If the resistance indicates an open circuit, there is either a break in the valve cable, or the valve is defective. In either case, the pneumatics module is defective. If the circuit indicates it is closed, there is likely a problem with the drive electronics. The Analog electronics board should be replaced.	The aspiration valve is connected to pins 7 & 8 of the control cable.
13.g	If the aspiration pinch valve opens as it should, but there is no vacuum, remove the top and bottom covers. Verify that the large hydrophobic filter is not filled with fluid.	The large hydrophobic filter protects the vacuum regulator from any aspirant that might escape from the 50cc chamber of the aspiration cassette. If a full cassette is left in the system while the it is turned on end, any aspirant in the 50cc chamber will drain into the vacuum regulator tubing and be caught in the hydrophobic filter.	If aspirant is found in the hydrophobic filter, it can be replaced without replacing the entire pneumatics module.
13.h	Remove the cover from the vacuum regulator and use a DVM to verify that +12VDC is present between terminals 1 and 3 inside the regulator. Adjust the aspiration level to maximum and depress the pedal fully. Verify that ~5VDC is present between terminals 2 and 3 inside the regulator	It is possible that there is a problem with the vacuum regulator. The regulator is powered with +12VDC from the Analog electronics board via the pneumatics control cable. The vacuum is controlled with a 0VDC to 5VDC signal. ~0VDC indicates 0mmHG while ~5VDC indicates 550mmHG. The footpedal, combined with the maximum aspiration setting, controls the amplitude of the signal.	There are adjustable thresholds of footpedal travel that must be passed to initiate aspiration. The thresholds are controlled in the PEDAL THRESHOLDS submenu of the current settings menu.

Step	Procedure	Rationale	Notes
13.i	If the voltages inside the regulator are incorrect, turn the system on its side and disconnect the pneumatic control cable from the Analog electronics board. Use a DVM to CAREFULLY measure the voltages on connector JP101 pins 1 & 2 with respect to pin 3	It is possible that a broken wire is the problem or a defective Analog electronics board. If the voltage between pins 2 and 3 is +12VDC and the voltage on pin 1 follows the footpedal position, then there is a problem with the pneumatics module. If the voltages are absent, the Analog electronics board is defective or there is a problem with the footpedal interface. +12VDC absent indicates the Analog electronics board is defective. The voltage on pin 1 not following the footpedal could be a footpedal problem.	If the voltage on pin 1 does not follow the footpedal position, perform the checks outlined in 11. Footpedal Interface Check. If these pass, the Analog electronics board is defective.

14. Air exchange check

Step	Procedure	Rationale	Notes
14.a	Install a hydrophobic filter and 3-way stopcock onto the air exchange male luer connector. Close the stopcock, enable the Air Exchange function, and verify that the Air Exchange LED turns green	Several internal checks are made by the system. If an error exists, the Air Exchange function will be disabled and the LED will be red. If the internal checks are OK, the Air Exchange status LED will be green. Suspect the keyboard if the Air Exchange LED will not light and there is no keyclick from depressing the key. (The keyclick could be disabled in the Audio Services submenu) Suspect the CPU if the display indicates that the Air Exchange mode has been entered but the LED is still extinguished.	The intensity of the LEDs is controlled in the LED INTENSITY submenu of the DISPLAY menu. Make sure that the intensity is up fully to see the status of the LEDs in a brightly lit room. Nine internal errors can keep the Air Exchange from operating. If the Air Exchange LED is RED, check for one or more of the following messages: **1) Air exchange excess** 2) Air pump failure 3) Air pump fuse failure 4) Air sensor failure 5) Eye pressure alarm 6) Eye sensor failure 7) High pump pressure 8) Low air pump pressure 9) Urgent system problem

Step	Procedure	Rationale	Notes
14.c	Perform this step only If the Eye sensor failure is displayed. Remove the top and bottom covers and inspect the LED on the Air exchange valve. This LED should be illuminated.	The Eye sensor failure alarm indicates that there is no pressure detected on the eye s side of the Air Exchange valve. Though the eye sensor could have failed, it is also possible that the valve failed to open on command. If the LED is illuminated, assume the Analog electronics board has failed. If changing the Analog electronics board does not correct the problem, the pneumatics module actually failed.	There is a remote possibility that the valve LED will be lit but the valve will fail to open. This trouble shooting procedure assumes the valve will open on command.
14.d	If the valve LED does not illuminate, turn the system on its side and disconnect the pneumatics control cable. Measure the resistance between pins 13 and 14. It should measure ~ 250 ohms.	There may be a broken wire / not fully seated connector / between the pneumatics module and the Analog electronics board. If the resistance indicates an open circuit, there is either a break in the valve cable, or the valve is defective. In either case, the pneumatics module is defective. If the circuit indicates it is closed, there is likely a problem with the drive electronics. The Analog electronics board should be replaced.	The air exchange valve is connected to pins 13 & 14 of the control cable.
14.e	Perform this step only if the Air pump fuse failure is displayed. Replace the pneumatics module. While the module is removed, replace fuse F103 with a new 1/2A fuse.	If the Air Exchange pump has seized, it will cause the air pump fuse to open. This fuse is not resettable and must be replaced.	There is a remote possibility that a short on the Analog electronics board could occur and also result in the Air pump fuse failure.
14.f	If the LED is green, adjust the Air Exchange pressure level to 50mmHg. Verify that the display indicates the set point and delivered pressure is 50mmHG. If it is not, there is likely a leak in the tubing or connections inside the system.	The Air Exchange pump is a low volume device. Excess flow will cause it to drop below the specified pressure.	Under no flow conditions, the set point and actual pressure should be identical. When there is considerable flow, the pump will not be able to keep up.

Step	Procedure	Rationale	Notes
14.g	Open the 3-way stopcock and verify that air flows from the opening	This action will prove that the control circuitry can follow changes in flow rate and that there is no partial blockage in the air path.	The Air Exchange is designed to work into a cannula. A larger opening than 20ga will deplete the available pressure.
14.h	If the valve LED does not illuminate, turn the system on its side and disconnect the pneumatics control cable. Measure the resistance between pins 13 and 14. It should measure ~ 250 ohms.	The A/D values display reports the actual voltage in hexadecimal. The motor voltage should be greater than D000. If the returned code is too small, the Analog electronics board is defective. If the code is in the range specified, the pneumatics module is defective.	The next release of the control software will change the readout to be in volts. The motor voltage should be greater than 20 volts.

15. Valve fuse failure checkout

Step	Procedure	Rationale	Notes
15.a	Disconnect the pneumatics control cable from the Analog electronics board. Verify that the Valve fuse failure message stops.	The valve fuse is used to supply power to the air control valves on the pneumatics module. All valves are supplied with +12VDC and a short of any of the wires will result in the fuse opening. If the message stops when the control cable is removed, the problem is on the pneumatics assembly. If the message persists, the problem on the Analog electronics board.	The status of the valve fuse can also be checked using the VALUES menu and the FUSE STATE submenu

16. Floppy disk drive checkout

Step	Procedure	Rationale	Notes
16.a	Check that none of the following messages are in the display: 1) Disk write protected 2) Diskette is full 3) Diskette read failure 4) Floppy fuse failure		

Step	Procedure	Rationale	Notes
16.b	If the Floppy fuse failure message occurs, there is either a problem in the floppy power cable or in the floppy drive itself. Remove the top and bottom covers. and inspect the floppy drive power cable.	Unless there is damage to the floppy drive power cable, the diskette drive is likely to be defective.	The floppy fuse is resettable. No additional steps are necessary to reset it.
16.c	If the Disk write protected message appears, verify that the floppy disk is not write protected. If it is write protected, move the plastic shutter so that the window is closed or select a different floppy.	There is a small sliding plastic shutter which write protects the disk when it is in the open position.	
16.d	If the Diskette is full or Diskette read failure messages occur, select a floppy whose contents can be lost. Format the floppy utilizing the FORMAT DISK submenu in the disk services menu.	The Syntec VitMan utilizes floppies in IBM format. The process of formatting the floppy will verify that the media and diskette drive are functioning correctly.	The format operation will destroy all data on the floppy. Make sure the floppy chosen contains no data that can not be lost.
16.e	If the diskette fails to format, either there is a problem with the electronics or there is a defect in the floppy. Try formatting a second floppy before continuing.	The Syntec VitMan requires error-free diskettes. The second attempt with a different floppy is to eliminate the possibility that the media was the only problem.	
16.f	Remove the top and bottom covers. Verify that the floppy drive control cable is firmly seated in the floppy drive and on the CPU electronics board. Verify also that there is no damage to the power cable.	If diskettes will not format, there is either a problem with the floppy drive control cable, the floppy drive, or the CPU electronics board. If the control cable is seated properly, the problem is most likely the floppy drive. Replace the floppy drive. If the problem remains, replace the CPU electronics board.	

17. Excess heat check

Step	Procedure	Rationale	Notes
17.a	Verify that the fan filter is not blocked or clogged and the light source exhaust is not blocked.	The primary air path for the Syntec VitMan is for air to enter through the fan filter, be circulated through the unit and then exhaust out the light source duct. Any blockage or obstruction will cause the unit to overheat.	If the fan filter is clogged, remove it and clean.
17.b	Verify that both fans are operating by removing the top cover. Inspect the main fan for rotation. Open the light source drawer and inspect the bulb fan for rotation.	If either fan has failed, it must be replaced. If neither fan is operating, check for a Fan fuse failure in the display.	
17.c	Verify that the Fan fuse failure is not in the display.	If the fan fuse has failed, either there is a short in the fan wiring or the bulb fan or the main fan has seized. The main fan connects to the Analog electronics board via connector JP111 while the bulb fan connects via connector JP109. These connectors allow the isolation to the fan which has the problem. Replace the appropriate defective fan.	

18. Noise Check

Step	Procedure	Rationale	Notes
18.a	Remove the top and bottom covers. Inspect the two shipping locks on the bottom of the unit.	The shipping locks are provided to prevent the pneumatics module from moving too far. If the screws are adjusted too tightly or too loosely, the pneumatics module will vibrate against the chassis.	
18.b	Inspect the blue motor mounts to make sure none of them are broken.	The motor mounts are constructed of silicone rubber. There are four on the bottom of the pneumatics module, three are used to mount the main compressor to the support bracket, and four are used to mount the vacuum pump to the support bracket.	

Step	Procedure	Rationale	Notes
18.c	Inspect the routing of the cable assemblies over and near the Analog electronics board. An out-of-location cable can cause a shifting of the pneumatics assembly and result in a rattle.		
18.d	Observe the system pressure. Use the CURRENT A/D VALUES display in the VALUES menu to display the current drive value.	A failure of the 50 PSI relief valve can result in the system running at a higher pressure than needed. This additional pressure will cause more motion in the main compressor as it operates and will result in additional noise in the unit. The value displayed as Drive should be between 45 and 55 PSI.	
18.e	Verify that all attachment bolts are securely tightened. This includes the front and rear panel mounting screws.		

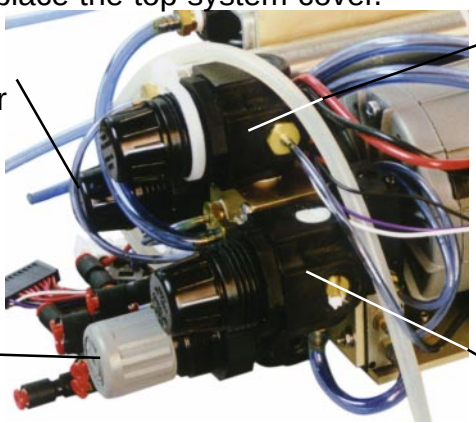
System Adjustment Procedures

Adjust Pressure Regulators

1. Remove the top system cover.
2. Turn the VitMan on. Install a cassette. Plug the aspiration port on the cassette.
3. Enter menu mode by pressing the display button. Select **Values** from the **Main Menu**. Select **Current A/D Values** from the **Values Menu** (see figure 1).

Note: The 3 pressure regulators and 1 pressure relied valve all have locking adjustment knobs. In order to adjust them, it is necessary to pull the knob away from the regulator body. It is usually necessary to disconnect and reconnect the pressure gage to the regulator output several times (or cause a change in flow load in some other manner) in order to receive a true pressure reading after the regulator has been adjusted. The internal mechanism needs to accommodate to the new adjustment and several readjustments may be needed before the regulator will work at the desired pressure.

4. Adjust the relief valve to obtain a reading of 2585 (2585 mmHg = 50 psi) on the drive sensor. This reading can be taken from the **A/D Values** screen on the front panel display. The adjustment can be checked by disconnecting and reconnecting the drive sensor tube labeled “4” at the quick disconnect. It should return to approximately the correct value after the tube has been reconnected.
5. Measure the vacuum regulator pilot pressure. It is most easily accessed at the output port of the vac. reg. regulator. Adjust the vac. reg. regulator to 20 psi.
6. Measure the cylinder operating pressure. It is most easily accessed at the tube exiting the pneumatic module labeled “1”. Connect the pressure gage to the tube at the quick disconnect. By pressing the aspiration pinch valve button, on the system front panel, pressure will be alternately supplied to this tube. Adjust the cylinder regulator to 30 psi. Simply causing the system to open and close the aspiration pinch valve (causing pressure to be routed to then vented away from the pressure gage) will change the load enough on the regulator to allow for a stable adjustment.
7. Measure the vitrector operating pressure. It is most easily accessed at the vitrector output on the system front panel. By pressing the manual valve actuation button, located on the side of the vitrector valve, pressure will be supplied to the vitrector output. Adjust the vitrector regulator to 42 psi. Opening and closing the vitrector valve (causing pressure to be routed to then vented away from the pressure gage) with the manual actuation button will change the load enough on the regulator to allow for a stable adjustment.
8. Replace the top system cover.



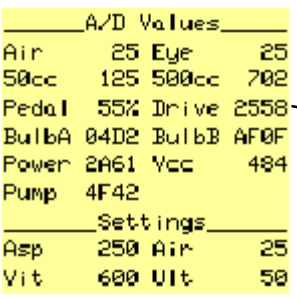
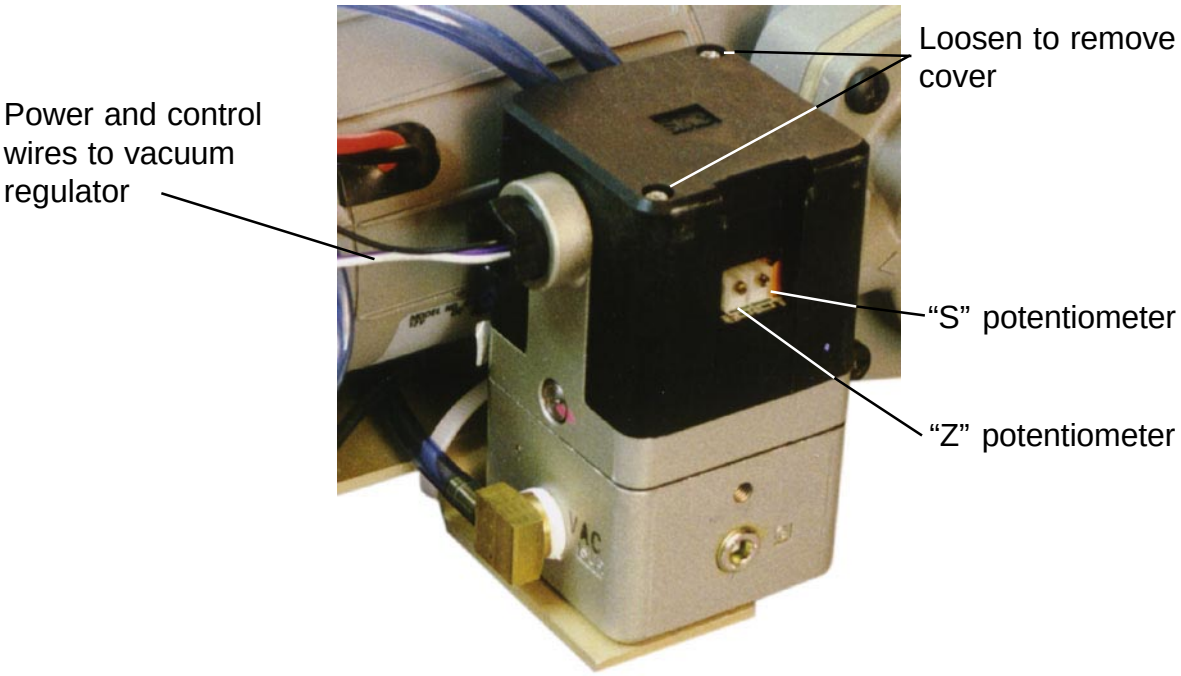


Figure 1

Adjust Vacuum Regulator

1. Remove the top system cover.
2. Loosen 2 screws holding the black cover to the vacuum regulator. Remove the vacuum regulator cover. Note the position of the vibration pad on the cover for later replacement.
3. Turn the VitMan on. Install a cassette. Plug the aspiration port on the cassette. Turn the aspiration surgical function on. Adjust maximum aspiration to 500.
4. Enter menu mode by pressing the display button. Select **Values** from the **Main Menu**. Select **Current A/D Values** from the **Values Menu** (see figure 1).
5. Measure the vacuum regulator pilot pressure. It is most easily accessed at the output port of the vac. reg. regulator located on the regulator manifold in the pneumatic module. The pressure should be set to 20 psi. If the pressure in incorrect, adjust the regulator by turning the knob. Note it should be necessary to unlock the knob by pulling away from the regulator body. It is usually necessary to disconnect and reconnect the pressure gage to the regulator output several times in order to receive a true pressure reading after the regulator has been adjusted. The internal mechanism needs to accommodate to the new adjustment and several readjustments may be needed before the regulator will work at the desired pressure.
6. Measure the power voltage to the vacuum regulator. The voltage is most easily accessed at the wire connector on the vacuum regulator. Measure between pins 1 and 3. The voltage should be 12Vdc. The 12Vdc supplied to the vacuum regulator is the same as that used for a lot of the sensitive analog circuitry on the analog electronics board. So if the rest of the VitMan seems to be operating, and the 12Vdc is low or missing, suspect a problem with the wires or the connector pins going to the analog electronics board.
7. Fully depress the foot pedal (it helps to put a weight on the foot pedal). The vacuum level in the 50cc chamber will eventually reach 500 (mmHg). Even if the vacuum regulator adjustment is incorrect the system software will try to compensate. The software will slowly adjust the command (voltage) given to the vacuum regulator until the 50cc chamber reads 500. If the system fails to reach 500, first calibrate the foot pedal. This is accomplished by entering the **Service Menu** from the **Main Menu**. Select **Calibration Routines** from the **Service Menu**. Then select **Calibrate Foot Pedal** from the **Calibration Routines** menu. Follow the directions on the screen. If the system still fails to reach 500 the vacuum regulator may be grossly out of adjustment, the software may not be able to adjust the voltage high enough to reach 500. If this is the case, adjust the potentiometer marked “S” on the vacuum regulator circuit board clockwise (as viewed from the end with the adjustment) in 1/4 turn increments until the system software is able to reach 500.
8. Measure the control voltage to the vacuum regulator between pins 2 and 3 on the wire connector. The reading should be 3.87Vdc. If the voltage is high, turn the potentiometer on the vacuum regulator circuit board marked “S” clockwise. Wait for the system software to return the vacuum to 500. Likewise, if the voltage is low then adjust the “S” pot counter clockwise. After the system has returned to 500, take a new voltage reading and adjust as necessary.

9. Adjust the maximum vacuum on the aspiration surgical function to 20. The foot pedal should remain fully depressed. The system software should adjust the vacuum level in the 50cc chamber to reach a value of 20. Measure the vacuum regulator control voltage between pins 2 and 3 on the wire connector. The reading should be 0.25Vdc. If the voltage is high, turn the potentiometer on the vacuum regulator circuit board marked “Z” clockwise. Wait for the system software to return the vacuum to 20. Likewise, if the voltage is low then adjust the “Z” pot counter clockwise. After the system has returned to 20, take a new voltage reading and adjust as necessary.
10. Unfortunately, the two adjustments interact. Adjust the maximum vacuum on the aspiration surgical function back to 500 and start again at step 8 until it is not necessary to make an adjustment of either the “S” or “Z” pots to obtain the correct voltage at both 500 and 20 mmHg vacuum.
11. Calibrate the aspiration function.



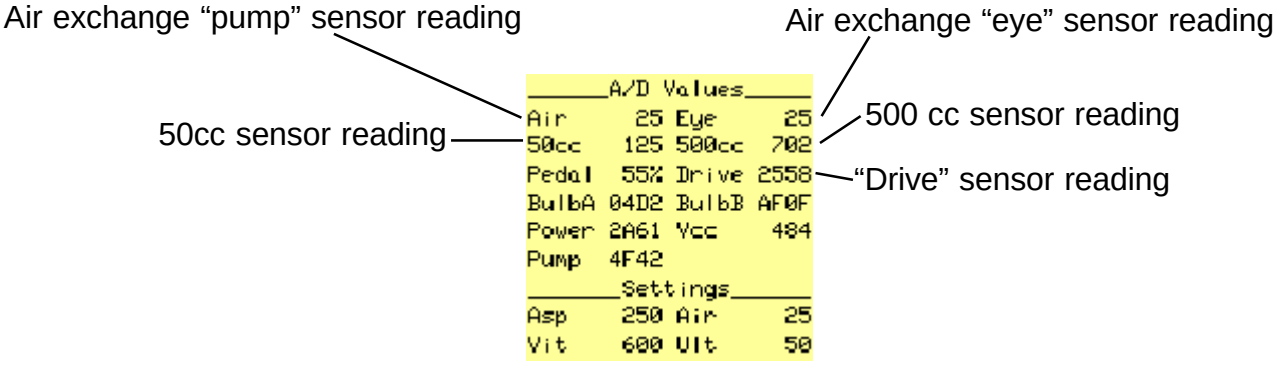


Figure 1

Calibrate Aspiration

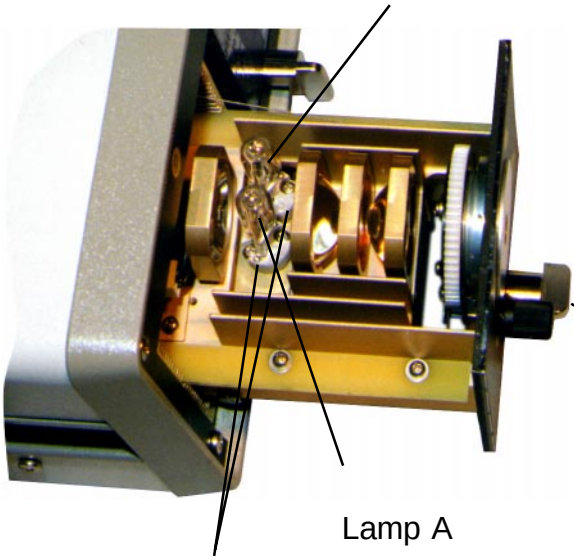
1. Calibrate the aspiration surgical function.
   a. The aspiration function should be off, a cassette inserted into the system, and the aspiration port plugged.
   b. Enter menu mode.
   c. Select **Service Menu** from the **Main Menu**.
   d. Select **Calibration Routines** from the **Service Menu**.
   e. Select **Maximum Aspiration** from the **Calibration Routines** menu.
   f. Press the enter button to complete the task. The calibration routine takes several minutes. It allows the system to calculate control values to correctly operate using the components installed in the system. The software finds the correct control for atmosphere (actually 1 or 2 mmHg vacuum) and for various maximum vacuum settings up to 500 mmHg. If the system fails to respond as expected at any stage during the process it will cause the calibration to fail and a message to appear on the display. The two most likely causes for a calibration failure are a cracked cassette and misadjustment of the vacuum regulator.

System Assembly/Disassembly Procedures

Light Source Lamp Replacement

The system light source has two incandescent lamps, located in the light source drawer. The light source requires only one lamp to operate correctly. The second lamp is used as a backup lamp. When the light source is operating, the lamps and surrounding components reach extremely high temperatures and will cause burns if touched. Time must be allowed for cooling prior to attempting to replace a lamp. The light source will cool most rapidly if the system is operating with the light source turned off. Never touch a good lamp with bare fingers. Body oils from fingerprints can cause the high strength quartz envelope of the lamp to develop weak areas. This can cause premature failure of the lamp or a reduction of light output from the source.

Photo. 1



1. Visually determine which lamp is burned out or missing and proceed to Step 5, or
2. Use the “Display” menu to determine which lamp is burned out or missing. The system software can determine the status of the lamps when the light source drawer is fully installed.
   a. To use the “Display” menu, press and hold the blue “Display” button on the front panel for one second until the display changes to the “Main Menu” screen. (It may be necessary to press the blue right arrow button to see the menu listing.)
   b. Select the “Service Menu” by highlighting it using the blue down arrow button.
   c. Press the blue right arrow button to display the “Service Menu” listing.
   d. Press the blue down arrow button to highlight “Service Illumination”.
   e. Press the blue right arrow button to display the “Service Illumination” listing.
   f. Highlight the “Display Bulb Info” and press the right arrow button to display “Bulb Information”. The “Bulb Information” display will indicate which lamp is bad or missing by declaring “”A” Bulb Is Missing” or “”B” Bulb Is Missing”. The number of hours on each lamp and the dates the lamps were last replaced are also noted.

3. Alternately, the system will display light source lamp status in the message bar, at the bottom of the display, when the system is operating. Also if the light source is turned on, and neither the vitrector nor ultrasound modes are turned on, the system will display light source information in the display area normally reserved for the vitrector or ultrasound modes.
4. Open the light source drawer.
5. Remove the lamp that has failed. Grasp the lamp envelope and pull up away from the lamp socket. The “A” lamp is on the left and the “B” lamp is on the right as indicated by marks on the drawer.
6. Cut the end of the new lamp’s packaging off near the pins. Use the packaging to hold the lamp. Insert the lamp into the empty lamp socket until the pins bottom in the socket. Do not touch it with bare fingers! Take care to insert the lamp in a fully upright perpendicular position.
7. Close the light source drawer. Make sure that the light source drawer stop cable loops inside the drawer.
8. Update the system’s lamp information. (Under normal situations where the lamp has gone bad while the system is operating, this procedure is done automatically.) Follow Step 2 through Step 2.e to go to the “Service Illumination” listing and highlight and select “Clear Bulb Hours”. Highlight the appropriate selection and press the blue right arrow button to zero the “Bulb Hours”. The date will be automatically updated.

Tools required

1. Scissors

System Fan Filter Maintenance

The System Fan Filter should be examined on a regular basis to determine the condition of the filter. It is located under the filter cover on the outside left of the back panel. A visual examination of the filter through the openings of the fan cover is adequate. If lent buildup is obvious the filter should be removed and cleaned or replaced with a new filter. If there are tears in the filter, it should be replaced with a new filter. The removable filter cover snaps into the fan filter housing and is held there with four short plastic ridges, one in the center of each of the four sides of the housing. See Photo. 1.

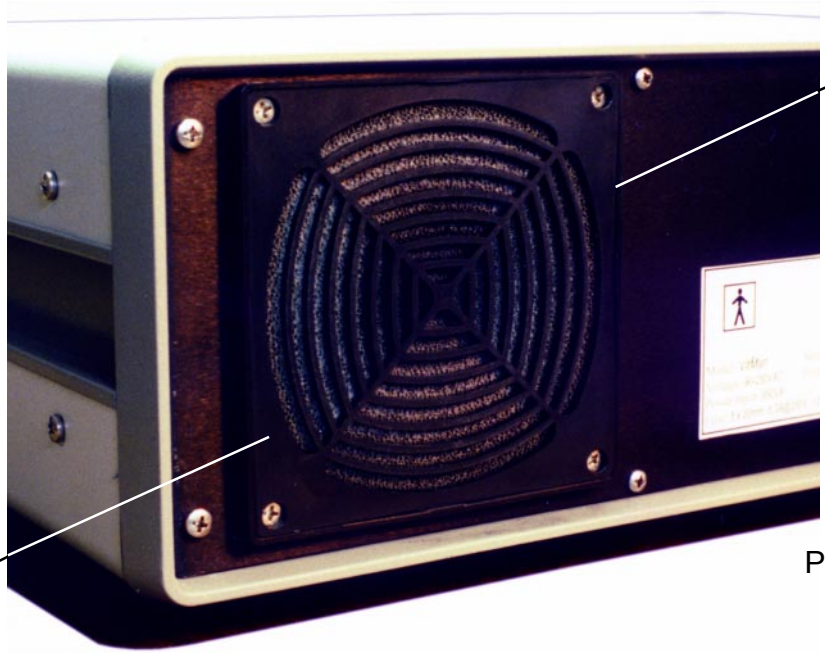


Photo. 1

1. Remove the fan filter by prying the fan cover off. This usually can be done with your fingers or if necessary carefully using a screwdriver.
2. Wash and rinse the filter with water and squeeze dry.
3. Replace the filter and snap the fan cover back into place.

Tools required

1. Small Bladed (flat tip) Screwdriver- optional

System Fuse Replacement

The system is protected against excessive AC current draw. The AC power fuse(s) is located inside the power entry module, which is on the right hand side of the system back panel. The power entry module has both North American and European fusing capabilities. The local power provided will determine the quantity and current rating of the fuse(s) required. If the local power is polarized, normally a single fuse and a shorting bar (provided) is used. If the local power is not polarized (power plug can be reversed), normally two fuses are used. Use fast blow 5 X 20 mm fuses, 6.3 ampere at 250 volts or 10 ampere at 125 volts for replacement fuses.

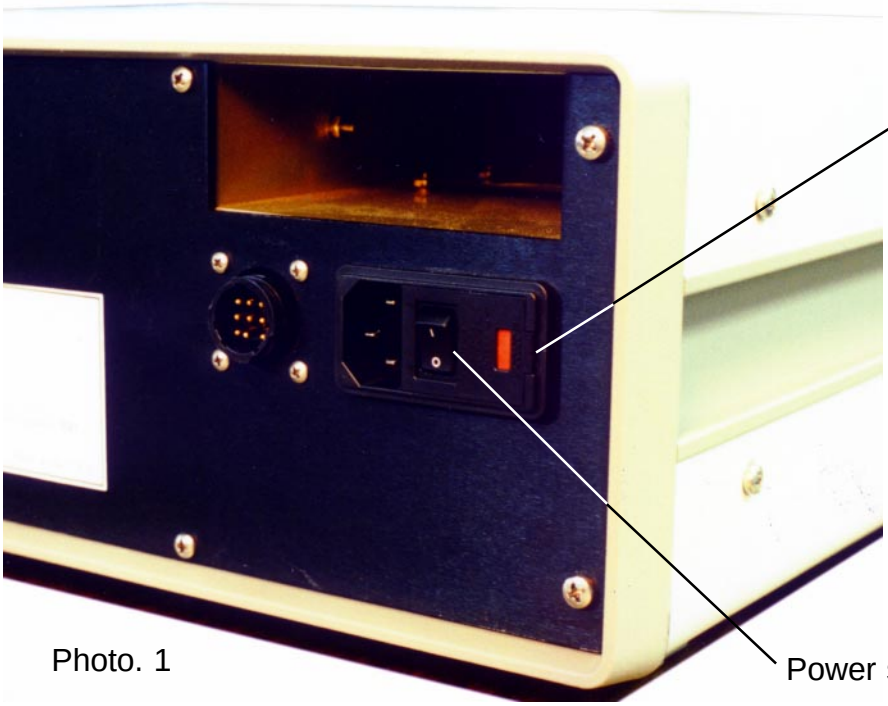


Photo. 1

1. Switch the rocker 0/1(ON/OFF) Switch to the 0 (OFF) position and remove the power cord from the back panel IEC connector.
2. Using a small bladed (flat tip) screwdriver, pry open the right hand side of the fuse cover on the power entry module to expose the red fuse holder. See Photo. 1.
3. Use the screwdriver to pry loose and remove the red fuse holder.
4. Visually check the fuses and replace blown fuses.

Single fuse holders are keyed by the shorting clip and will only fully install in one way. Fuse holders set for dual fuses are not keyed and will install either way.

5. Install the fuse holder into the power entry module.
6. Snap closed the fuse holder cover.
7. Replace the power cord into the power entry IEC connector.

Tools required

1. Small bladed screwdriver - approximately 3 mm or 1/8 inch.

System Cover Removal

1. Remove the system power cord, to make sure that power is removed from the system.
2. Remove the two large rubber feet that hold the back panel to the chassis.
3. Replace one screw in each side of the back panel to keep the back panel in place. See Photo 1.
4. Remove eight (8) screws from the sides of the system.
5. Lay the system on it's left side, use the handle as a stabilizer. See Photo 2.
6. Loosen the top and bottom covers, disconnect the two earth ground wires from the covers.
7. Remove the top and bottom covers.

Photo. 1

Remove 8 screws (4 each side)

Remove 2 screws per foot. Replace 1 screw per side, after feet are removed.

Disconnect power cord

Earth ground wires are located here.

Photo. 2

Tools Required

1. #2 Phillips screwdriver

System Cover Installation

1. Remove the system power cord, to make sure that power is removed from the system.
2. Lay the system on it's left side, use the handle as a stabilizer. See Photo 1.

Both the top and bottom system covers should be connected to the chassis with an earth ground wire. There are two green w/ yellow striped earth ground wires attached to the chassis. A tab is welded on the inside of each cover that accepts the connector on the other end of the earth ground wires. See Photo. 1.

3. Connect the earth ground wire to each cover.
4. Place the top and bottom covers onto the chassis.
5. Lay the system on it's bottom.
6. Install eight (8) screws in the sides of the system.
7. Remove the two screws that are holding the back panel in place.
8. Install the two large rubber feet that hold the back panel to the chassis. See Photo. 2.

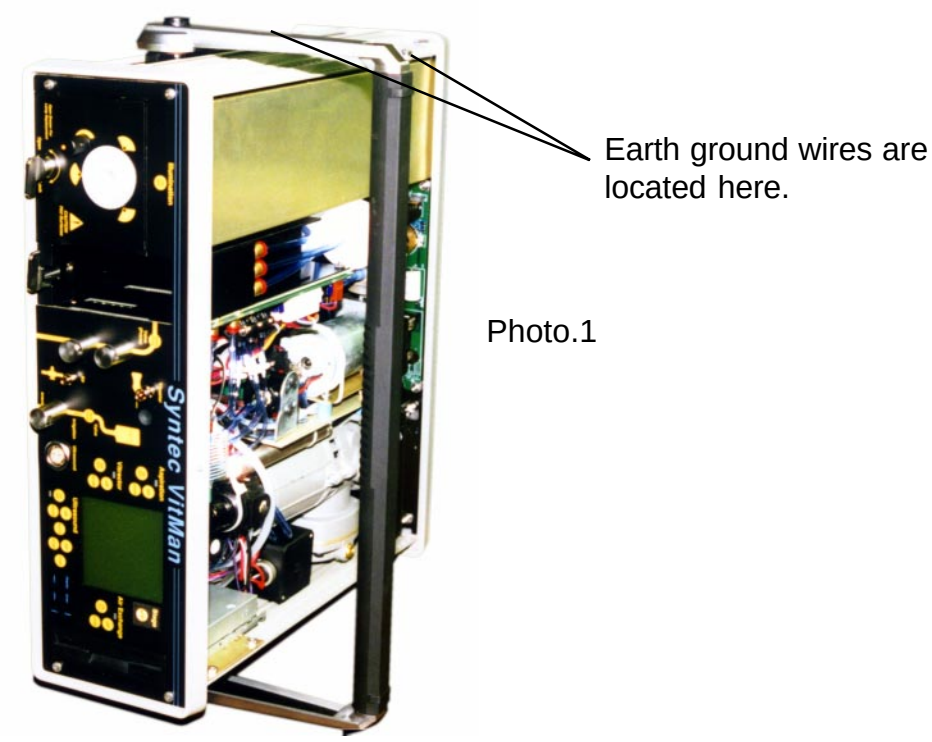


Photo.1

Photo. 2

Install 8 screws (4 each side)

Remove 1 screw per side. Install feet with two screews.

Edges of covers fit into grooves in chassis sides.

Tools required

1. #2Phillips screwdriver

Hydrophobic Filter Replacement

The aspiration function in the system uses hydrophobic air filters to protect against ingress of fluids. These filters will allow air to flow freely, but will block passage of fluids. A filter needs to be replaced if it becomes filled with fluid. Precautions should be taken if there is any chance that the fluid is a biohazard. Any fluids aspirated during surgery or aspirated into a aspiration cassette that hasn't been sterilized since surgery should be considered a biohazard.

1. Perform system cover removal procedure.

The two hydrophobic filters are connected to the back of the cassette manifold. One filter is slightly larger than the other. The filters have barbed connections on both sides. Tubes are pressed onto the barbs and connect the filters to the system. The larger filter is connected to the cassette manifold port nearest the air duct. The smaller filter is connected to the middle back cassette manifold port. To release a tube from a manifold quick disconnect: depress the red ring on the quick disconnect, then pull the tube from the connector. To connect a tube to a manifold quick disconnect: insert the tube into the hole in the end of the quick disconnect until it bottoms, then tug the tube away from the quick disconnect to seat it. A pair of needle nose pliers can be used to pry off the tubing connected to either side of the filter. To replace the larger filter it will be necessary to disconnect the smaller filter at the cassette manifold. This will make room to pull the larger filter out of the system.

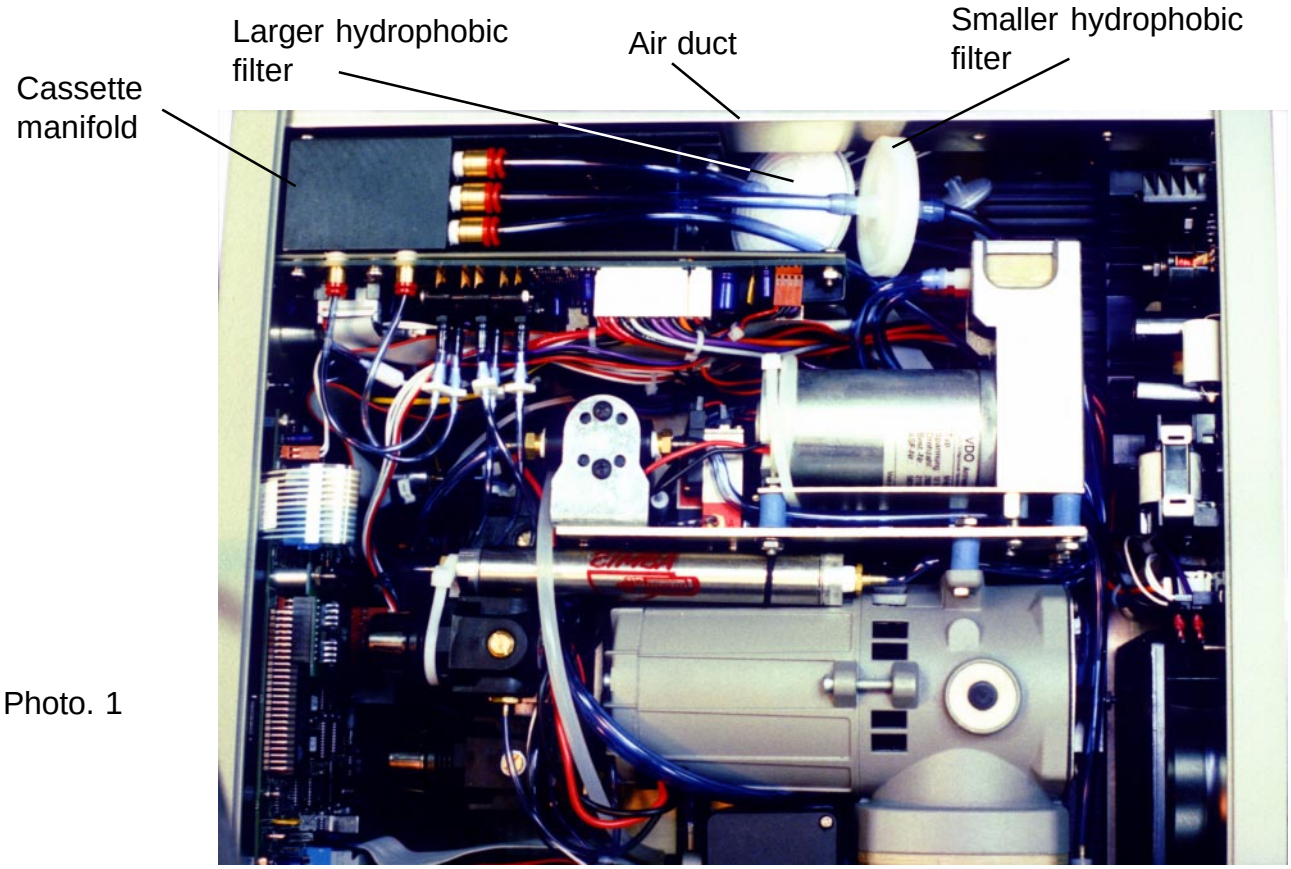


Photo. 1

The filters should be oriented correctly when a new one is installed. The side of the filter marked with either “VAC” or a green dot should be connected to the tube that doesn’t connect to the cassette manifold. The barbs on the filter should be firmly seated in the tubes. After the filter(s) have been connected to the tubes, they should be placed back into their original positions in the system. The tubes should then be connected to the cassette manifold. See Photo. 1.

2. Disconnect the necessary tube(s) from the cassette manifold.
3. Disconnect the tubes from the filter(s).
4. Attach the tubes to the new filter(s).
5. Place the filter(s) into the system.
6. Connect the tube(s) to the cassette manifold.
7. If desired, perform the system cover installation procedure.

Tools Required

1. Needle nose pliers
2. Refer to the tool requirement for all procedures referenced in this procedure.

Pneumatic Module Removal

1. Perform system cover removal procedure.

Plastic tubing connects the pneumatic module to various components in the system. Each tube has a quick disconnect to aid component replacement. There are ten in-line quick disconnects accessible from the bottom of the system. The tubing on either side of the quick disconnect is labeled (0-9) to allow reconnection of the correct tubes. The tube is released by depressing the red ring towards the black shell of the quick disconnect. While depressing the red ring, pull the tube from the quick disconnect. To reconnect the tube grasp the black shell of the quick disconnect, insert the appropriate tube into the opening in the end of the red ring until it stops. Tug the tube away from the quick disconnect to seat the tube and ensure proper insertion. See Photo. 1 and Fig. 1

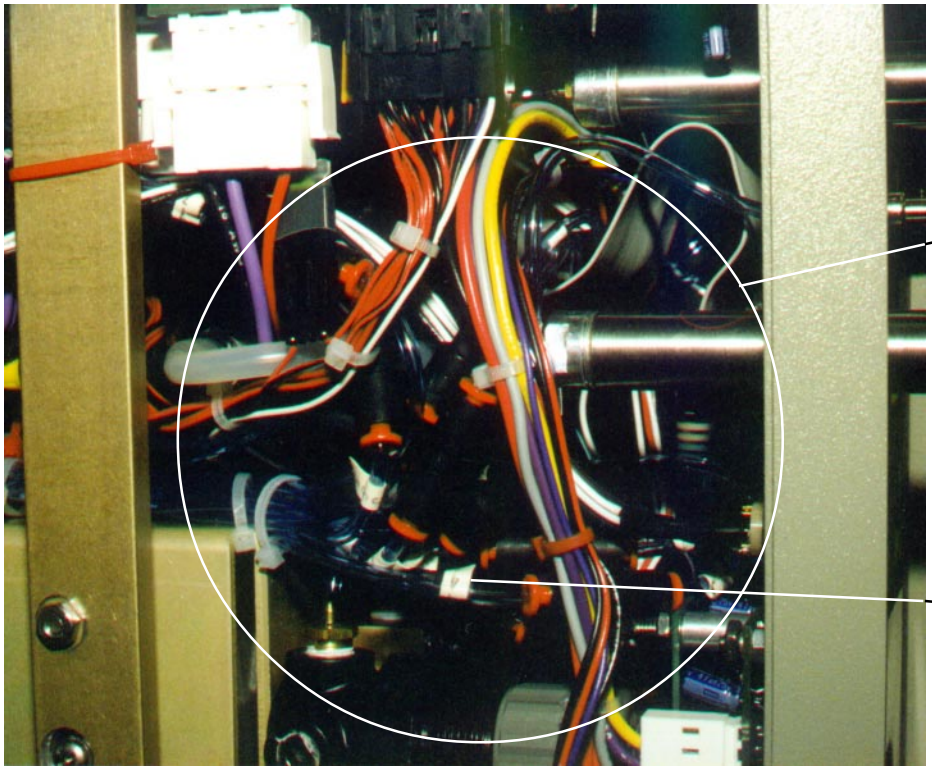


Photo. 1
Bottom Front of system

Tube quick disconnect In Line Connector

Fig. 1

2. Disconnect ten (10) tubes labeled 0-9 at the quick disconnects from the pneumatic module.

Power and control signals are routed through two cables connected to the analog electronics board. The first cable connector has two retainer/ejector levers that must be moved to the side to release the connector. The second cable uses release catches that must be squeezed from the side to release the connector. Note that the levers for the first cable should be returned to their original position after the cable has been disconnected. These levers protrude from the bottom of the system when in the release position. If the system is set on it's bottom, with these levers pointing down, the levers can be broken. See Photo. 2

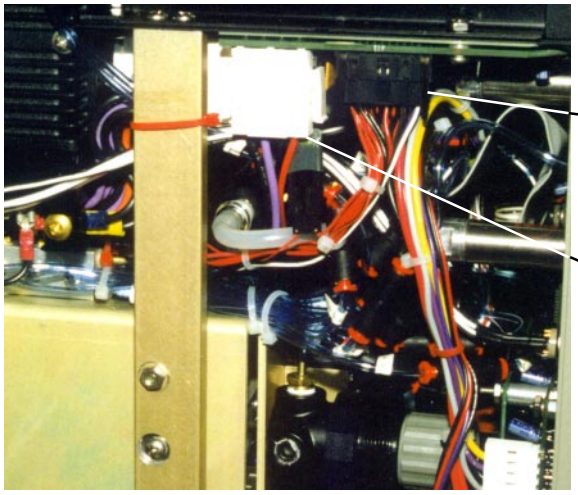


Photo. 2

3. Disconnect two (2) cables attaching the pneumatic module to the analog electronics board.

There are three tubes connected to the rear of the cassette manifold, accessible from the top of the system. The tubes aren't labeled because they can be identified by the type or lack of hydrophobic filter attached to them. The tubes can be disconnected or connected in a manner similar to the in-line quick disconnects. See Photo. 3

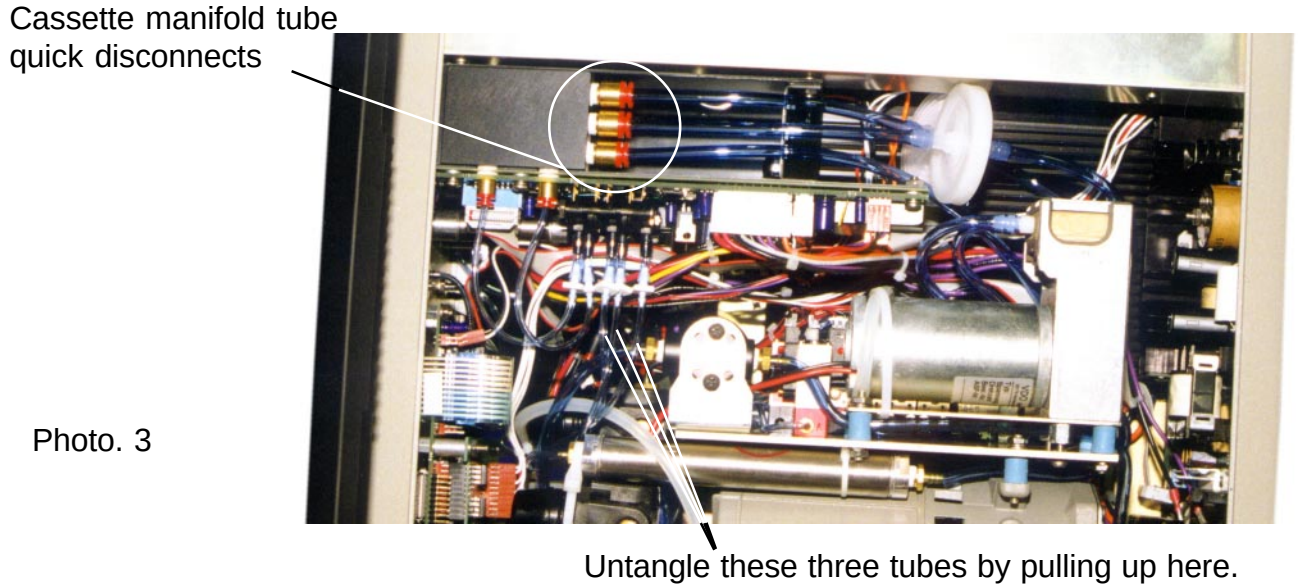


Photo. 3

4. Disconnect three (3) tubes from the rear of the cassette manifold.
5. Untangle three (3) tubes, that connect the pressure transducers on the analog electronics board, by pulling them free from the pneumatic module area of the system. See Photo. 3.

The pneumatic module is mounted into the system with four elastic shock mounts. The shock mounts consist of a cylindrical elastomeric center section with threaded fasteners on either end. One end of the shock mount is attached to the pneumatic module bracket, the other end attaches to the structural rails spanning the system enclosure. In order to detach the shock mounts from the structural rails the pneumatic module must be compressed towards the structural rails (system bottom). This can be accomplished by pressing with one hand against the top of the pneumatic module simultaneous to loosening the nuts under the structural rail. The pressure will help keep the shock mounts from twisting when the nuts holding them to the structural rails are loosened. Note that it is important that the shock mounts not be twisted more than approximately 1/4 turn on either disassembly or assembly. Too much twisting will result in a torn shock mount. In addition to the shock mounts, two motion restraint assemblies are connected between the structural rails and the pneumatic module bracket. The assembly consists of a screw and a threaded spacer. To disassemble first loosen the spacer away from the bottom of the pneumatic module. Then unscrew the screw from the threaded hole in the bottom of the pneumatic module. It will be necessary to hold the threaded spacer, to keep it from turning, while the screw is being turned. Note that it is not necessary to diassemble the motion restraint assemblies from the structural rails. See Photo. 4.

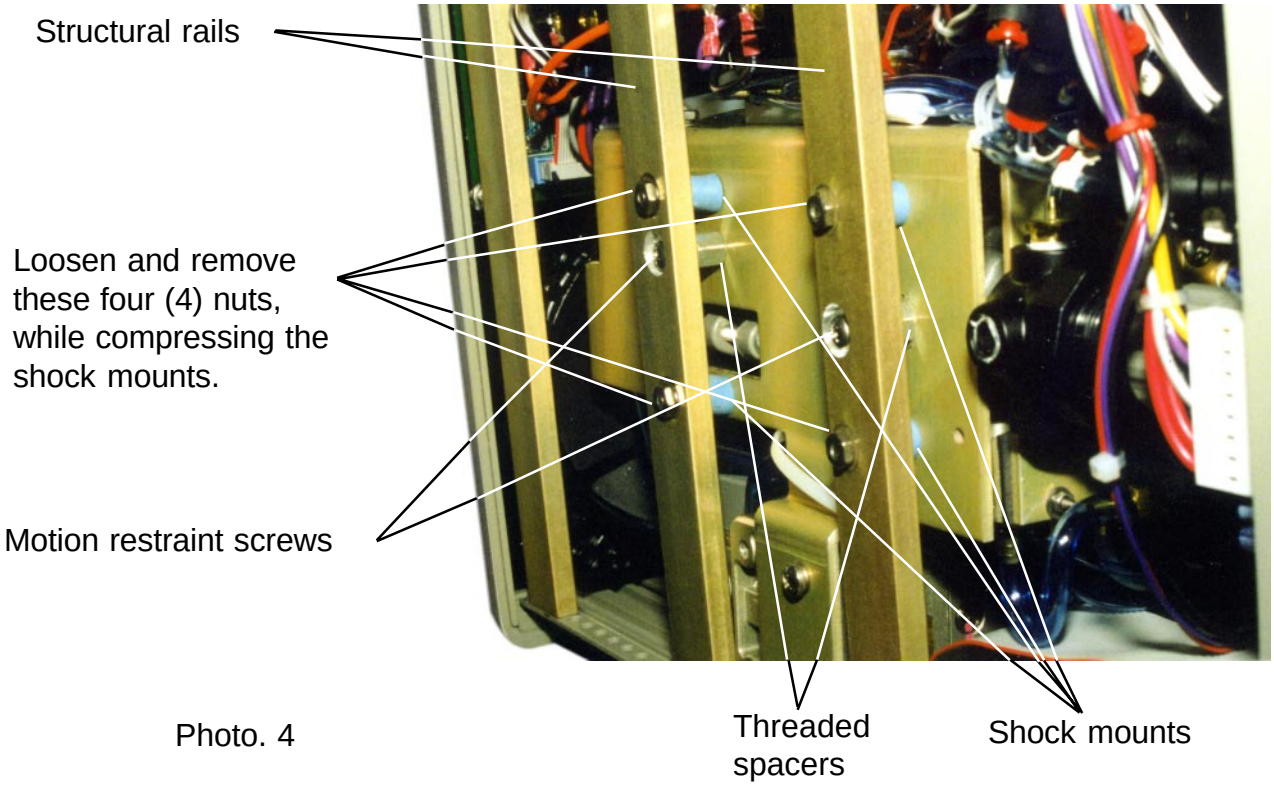

Structural rails
Loosen and remove these four (4) nuts, while compressing the shock mounts.
Motion restraint screws
Threaded spacers
Shock mounts

Photo. 4

6. Disconnect four (4) shock mounts from the structural rails on the system bottom.
7. Detach both motion restraint assemblies from the bottom of the pneumatic module.
8. Remove the pneumatic module from the system by pulling outward from the top of the system. Take care to untangle any system tubes or cables that may be tangled with the components of the pneumatic module.

Tools Required

1. #2 Phillips screwdriver
2. 3/8 inch wrench
3. 11/32 inch wrench or nutdriver
4. Refer to the tool requirement for all procedures referenced in this procedure.

Pneumatic Module Installation

System components that should be installed prior to performing this procedure:

1. light source enclosure & light source fan
2. power supply
3. cassette housing
4. analog electronics board

System components that are optionally installed prior to performing this procedure:

1. front panel
2. back panel
3. floppy disk drive

The pneumatic module should be fully assembled, including filters, prior to performing this procedure. Unless otherwise noted the system should be placed on it's left side to perform this procedure. The system handle should be rotated to stabilize the system in this position.

1. Put the pneumatic module into it's position in the system. Take care to avoid tangling any system tubes or cables with the components of the pneumatic module. See Photo. 1.

The pneumatic module is mounted into the system with four elastic shock mounts. The shock mounts consist of a cylindrical elastomeric center section with threaded fasteners on either end. One end of the shock mount is attached to the pneumatic module bracket, the other end attaches to the structural rails spanning the system enclosure. In order to attach the shock mounts to the structural rails the pneumatic module must be compressed towards the structural rails (system bottom). This can be accomplished by pressing with one hand against the top of the pneumatic module simultaneous to tightening the nuts under the structural rail. The pressure will help keep the shock mounts from twisting when the nuts holding them to the structural rails are tightened. Note that it is important that the shock mounts not be twisted more than approximately 1/4 turn on either disassembly or assembly. Too much twisting will result in a torn shock mount. See Photo. 2.

Photo.1

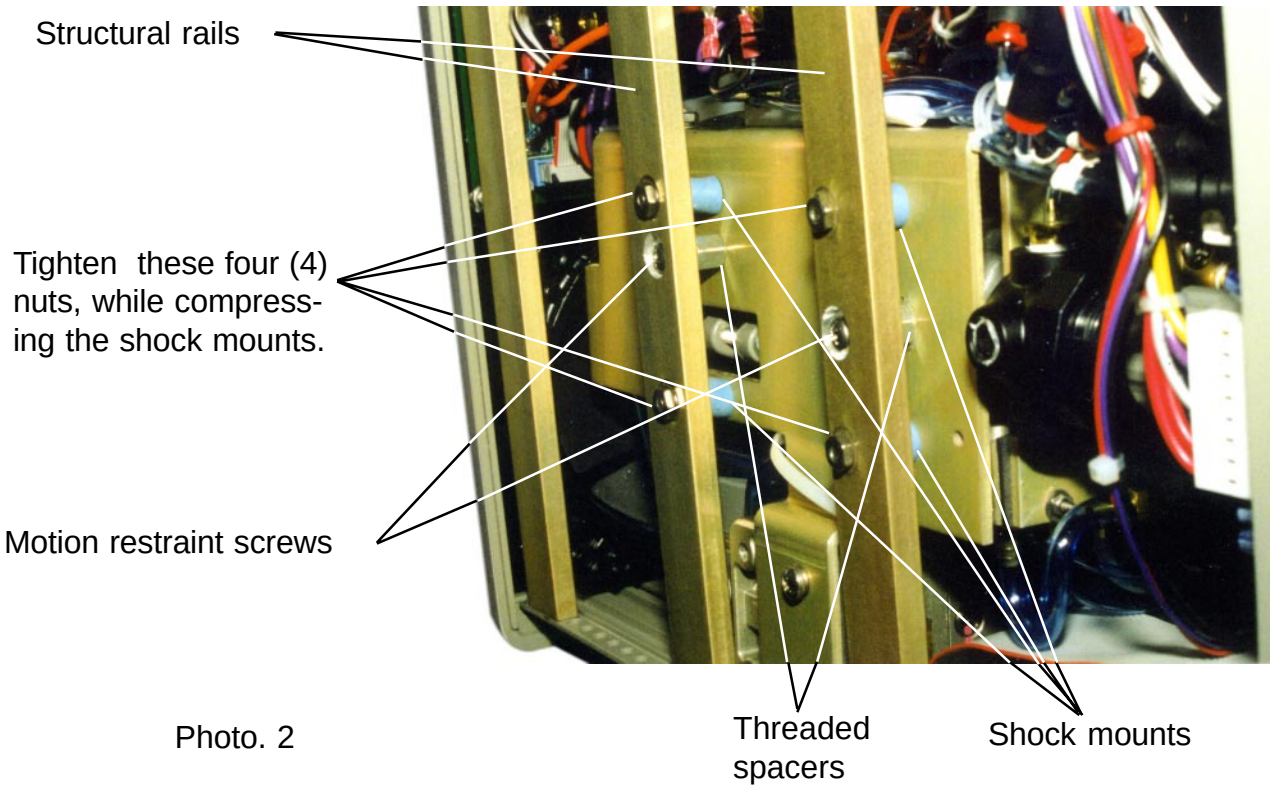
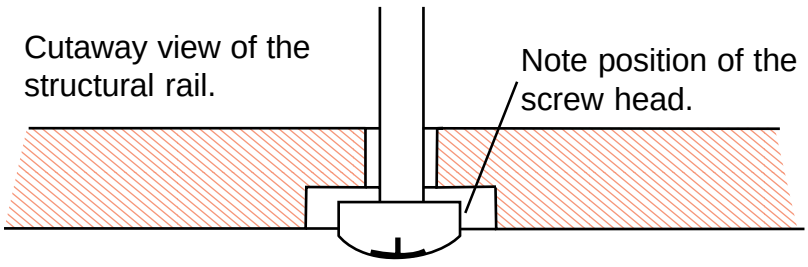


Photo. 2

2. Connect four (4) shock mounts to the structural rails on the system bottom.

In addition to the shock mounts, two motion restraint assemblies are connected between the structural rails and the pneumatic module bracket. The assembly consists of a screw and a threaded spacer. They should already be assembled to the structural rails. The screw should pass through the hole in the structural rail, with the screw head towards the bottom of the system. The threaded spacer should be threaded onto the screw on the opposite side of the structural rail. To attach the motion restraint assembly to the pneumatic module bracket, screw the end of the screw into the threaded hole in the bottom of the pneumatic module. It will be necessary to hold the threaded spacer, to keep it from turning, while the screw is being turned. To determine the correct depth of installation for the screw it is necessary to temporarily lay the system on it's bottom. The curved portion of the screw head should just be visible protruding from the counter bores in the structural rail. Installing the screw either too deep or shallow will cause the pneumatic module to rattle when it operates. After the screw depth is adjusted correctly, tighten the threaded spacer against the bottom of the pneumatic module. See Photo. 2 and Fig. 1.

Fig. 1



3. Attach both motion restraint assemblies to the bottom of the pneumatic module.
4. Insert three (3) tubes, that connect the pressure transducers on the analog board, through the pneumatic module tubing, towards the bottom of the system. See Photo. 3.

Plastic tubing connects the Pneumatic module to various components in the system. Each tube has a quick disconnect to aid component replacement. There are ten in-line quick disconnects accessible from the bottom of the system. The tubing on either side of the quick disconnect is labeled (0-9) to allow reconnection of the correct tubes. The tube is released by depressing the red ring towards the black shell of the quick disconnect. While depressing the red ring, pull the tube from the quick disconnect. To reconnect the tube grasp the black shell of the quick disconnect, insert the appropriate tube into the opening in the end of the red ring until it stops. Tug the tube away from the quick disconnect to seat the tube and ensure proper insertion. In order to minimize tangling and to keep the space taken by the quick disconnects to a minimum, the tubes should be connected in a specific order: 2,3,4,8,1,6,9,5,7,0. See Photo. 3 and Fig. 2.

5. Connect ten (10) tubes labeled 0-9, at the quick disconnects, to the pneumatic module.

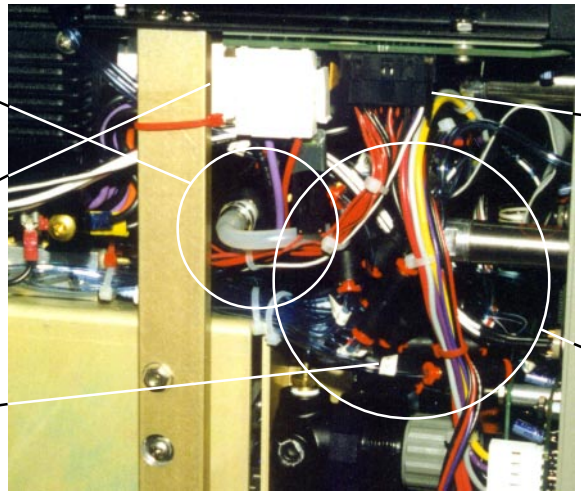


Photo. 3

Tube quick disconnect in-line connector

Fig. 2

Power and control signals are routed through two cables connected to the analog board. The first cable connector has two retainer/ejector levers that must be moved to the side to release the connector. The levers also must be moved to the side to allow the cable connector to be inserted. The second cable uses release catches that must be squeezed from the side to release the connector. However, inserting the cable connector until it bottoms on the printed circuit board connector is all that is required to connect it. Note that the levers for the first cable should be returned to their original position any time the cable is disconnected. These levers protrude from the bottom of the system when in the release position. If the system is set on it's bottom, with these levers pointing down, the levers can be broken. See Photo. 3.

6. Connect two (2) cables attaching the pneumatic module to the analog electronics board.

The pneumatic module has a coalescing filter that uses a silicone rubber tube to drain accumulated moisture (very minor amounts ever accumulate). This tube needs to be routed correctly to avoid it being pinched. It should first be pulled to extend from the bottom of the system. Then it should be routed through the other tubing towards the top of the system. It should then go over the air pressure regulators on the front of the pneumatic module. The end of the tube should then be routed down beside the vitrector valve. See Photos 3 and 4.

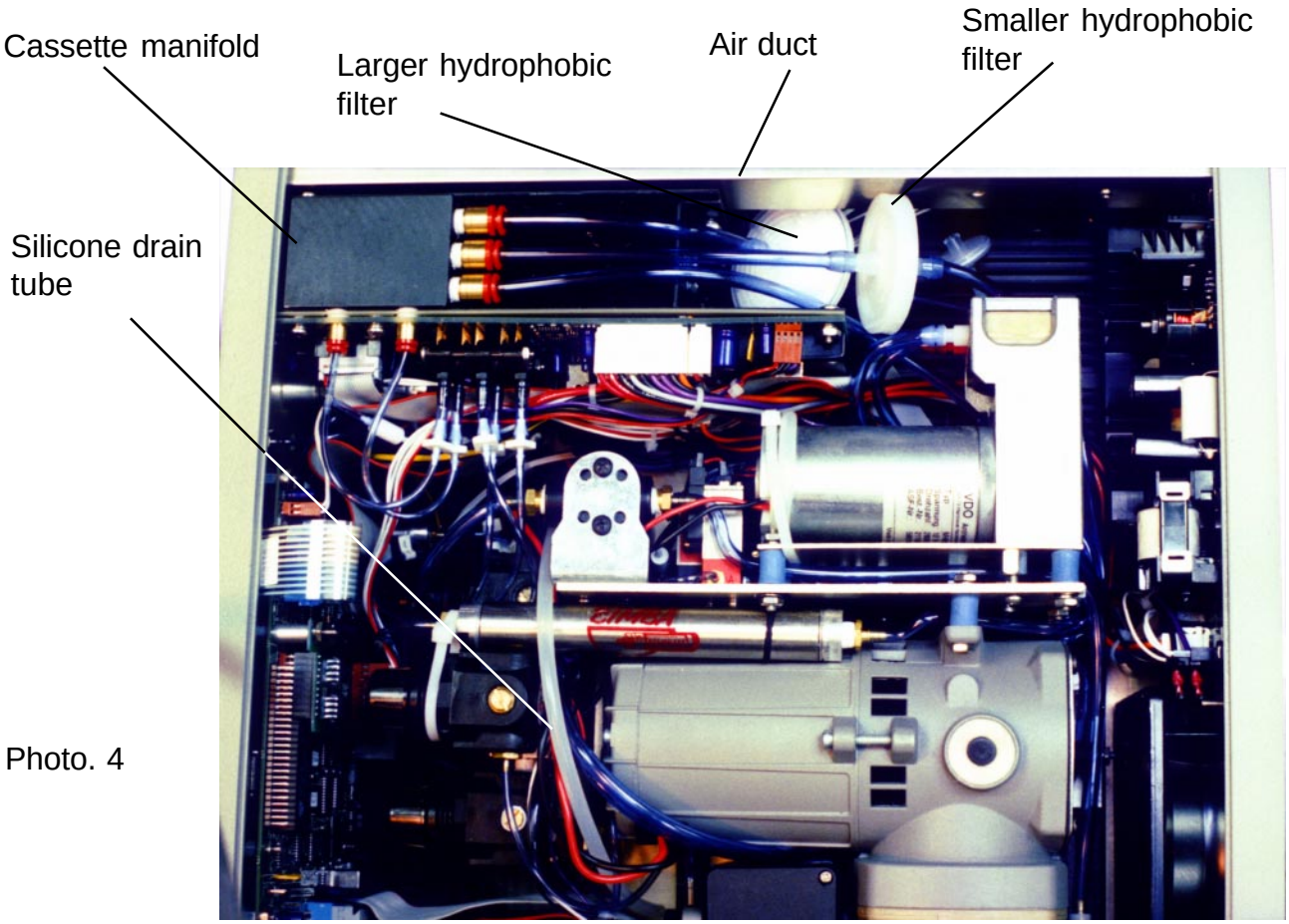
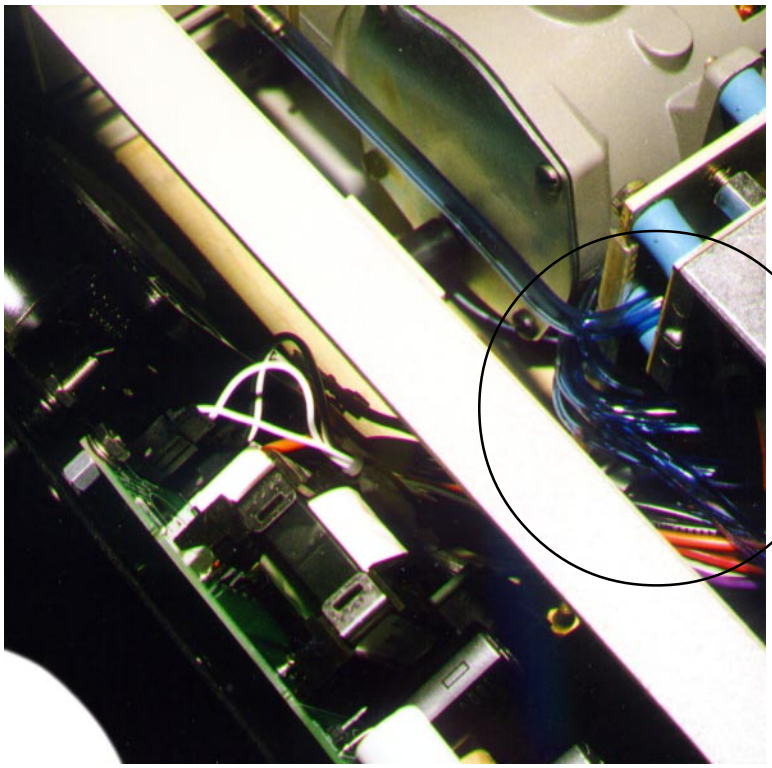


Photo. 4

7. Route the air filter drain.

There are three tubes that exit the pneumatic module from the rear, near the vacuum pump. These tubes route vacuum to the cassette, vacuum regulator, and vacuum pump. They should be connected to the rear of the cassette manifold and are accessible from the top of the system. The tubes aren't labeled because they can be identified by the type or lack of hydrophobic filter attached to them. The first tube that should be connected is the one with the largest filter attached to it in-line. This tube eventually connects to the vacuum regulator output on one end and the 50cc cassette chamber quick disconnect on the other. Place the filter on top of the power supply, at the back of the cassette housing. The side of the filter goes slightly under the light source air duct. Connect the tube to the quick disconnect fitting that is on the rear of the cassette manifold nearest the air duct. The connection is made by inserting the end of the tube into the hole in the end of the quick disconnect until it bottoms. Tug the tube away from the fitting to seat it. The second tube that should be connected is the tube that doesn't have any in-line filter. This tube is connected to the vacuum regulator input at one end and one of the 500cc cassette chamber quick disconnects on the other end. It should be connected to the quick disconnect fitting on the rear of the cassette manifold that is furthest from the air duct. The third tube to be connected, is the tube with a slightly smaller in-line filter than the first one. This tube is connected to the vacuum pump on one end and one of the 500cc cassette chamber quick disconnect on the other end. Connect it to the middle quick disconnect fitting on the rear of the cassette manifold. The filter should lay on top of the second tube. It is important that the tubes be routed correctly to avoid rubbing on various components in the system as the pneumatic module vibrates during normal operation. See Photos 4 and 5.



Correctly placed tubing at the rear of the pneumatic module. Note that the tubes are as close as possible to the back of the pneumatic module.

The back panel is shown detached to aid visibility only.

Photo. 5.

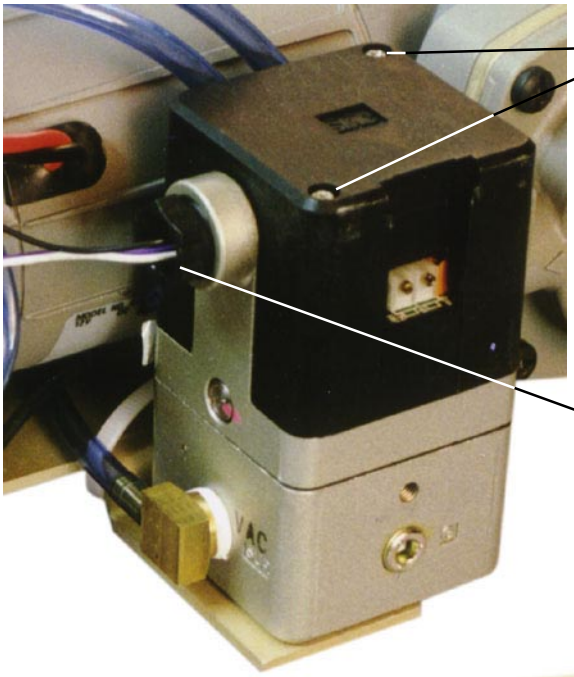
8. Lay the system on it's bottom. Connect three (3) tubes to the rear of the cassette manifold.

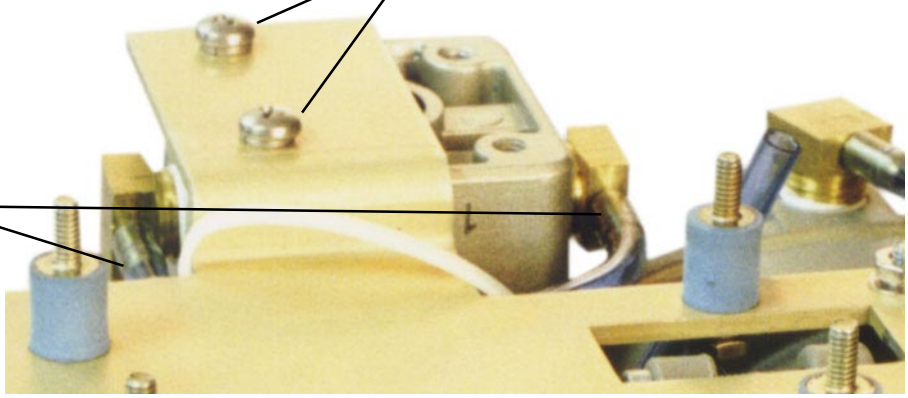
Tools Required

1. #2 Phillips screwdriver
2. 3/8 inch wrench
3. 11/32 inch wrench or nutdriver

Replace Vacuum Regulator

1. Remove the pneumatic module from the system.
2. Loosen 2 screws holding the black cover to the vacuum regulator. Remove the vacuum regulator cover.
3. Disconnect 3 wires from the orange connector block on the top of the vacuum regulator. Note the position of the wires for later connection.
4. Disconnect 2 1/4” air tubes from the side connections to the vacuum regulator. Again, note the position of the tubes for later connection.
5. Remove the 2 screws holding the vacuum regulator to the pneumatic module bracket.
6. Pull the vacuum regulator away from the pneumatic module assembly. Remove the remaining 1/8” air tube from its connection.
7. Reverse the above steps to reassemble.
8. Test the VitMan aspiration function. The actual vacuum level will probably be incorrect because the system has not been calibrated for the new vacuum regulator. However, the vacuum should respond to commands from the foot pedal.
9. Calibrate the aspiration function.





Analog Electronics Removal

1. Perform the system cover removal procedure.
2. Perform the pneumatic module removal procedure.
3. Perform the front panel removal procedure. Step 2 of the front panel removal procedure was accomplished in the pneumatic module removal procedure.

The Analog electronics board is mounted to the side of the cassette housing using seven screws. Each screw has a spacer between the printed circuit board and the side of the cassette housing. A fiberglass insulator protects the back side of the printed circuit board from the side of the cassette manifold. Four of the screws pass through the side of the cassette housing and are retained with nuts and locking hardware. One screw mounts into a countersunk hole in the inside of the cassette housing, passes through the printed circuit board, and is retained by a nut and locking hardware on top of the printed circuit board. The final two screws attach into the side of the cassette manifold.

There are thirteen cables connected to the analog electronics board. The two cables that go to the pneumatic module were disconnected when the pneumatic module was removed. Of the remaining eleven cables:

Two have ejecter/retainer levers on the printed circuit board connectors. The levers must be moved to the side to eject the cable connector.

Three have catches on the sides that must be squeezed to release the cable connectors.

Six have a pliable catch that doesn't use a release mechanism. To disconnect the cable, pull the cable connector away from the printed circuit board connector.

Five air tubes connect to the five air pressure sensors on the analog electronics board. Three of the tubes were disconnected when the pneumatic module was removed. The other two tubes go to the cassette manifold. They can be disconnected from the cassette manifold by pushing the red ring in, then pulling the tube from the quick disconnect (refer to the Pneumatic module removal procedure). See fig. 1 and photo. 1.

4. Disconnect eleven (11) cables from the analog electronics board.
5. Disconnect two (2) tubes from the cassette manifold.
6. Disassemble seven (7) screws attaching the analog electronics board to the side of the cassette housing.

Tools Required

1. #2 Phillips screwdriver
2. 11/32 inch wrench
3. 1/4 inch wrench

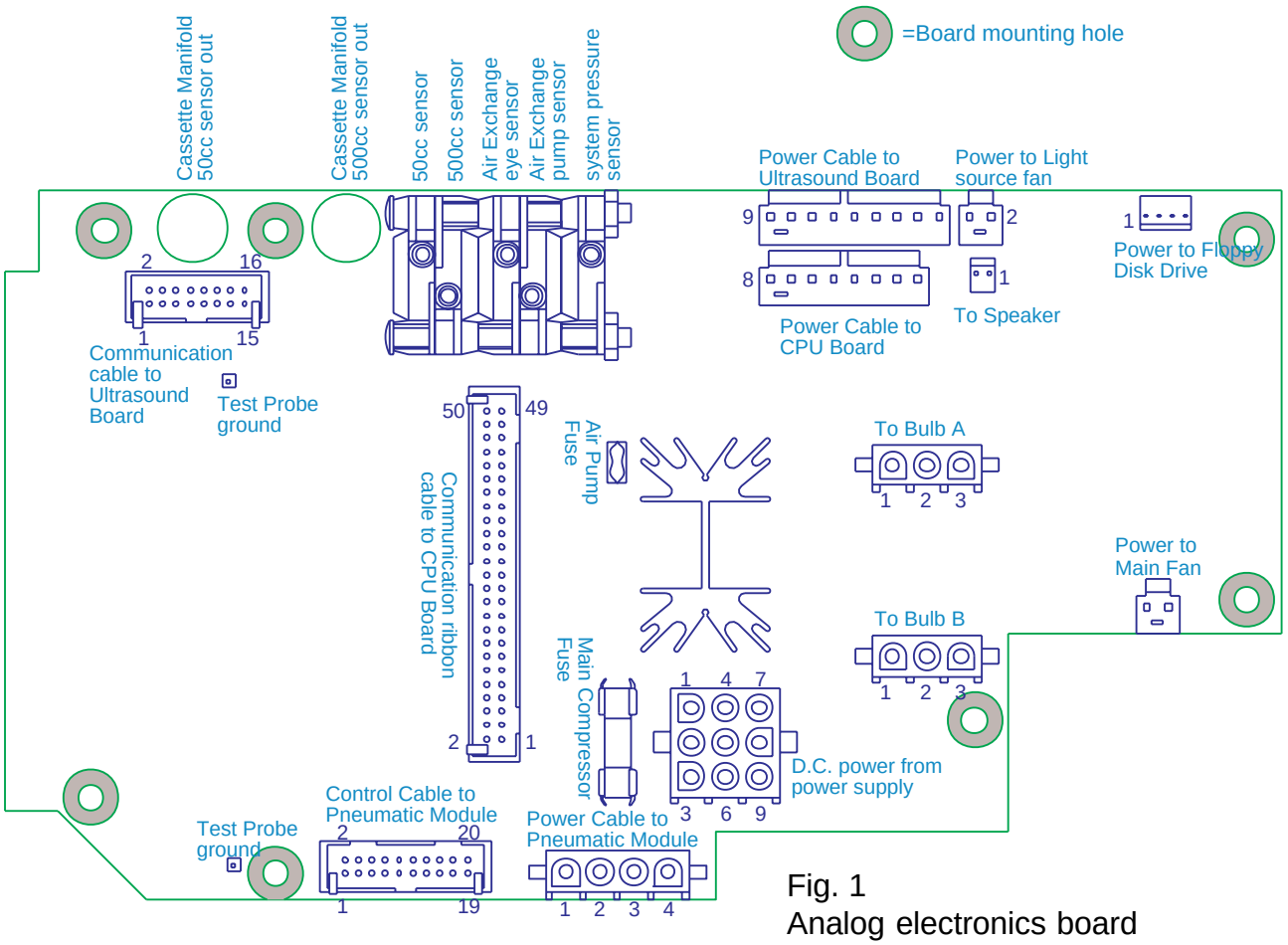


Fig. 1
Analog electronics board

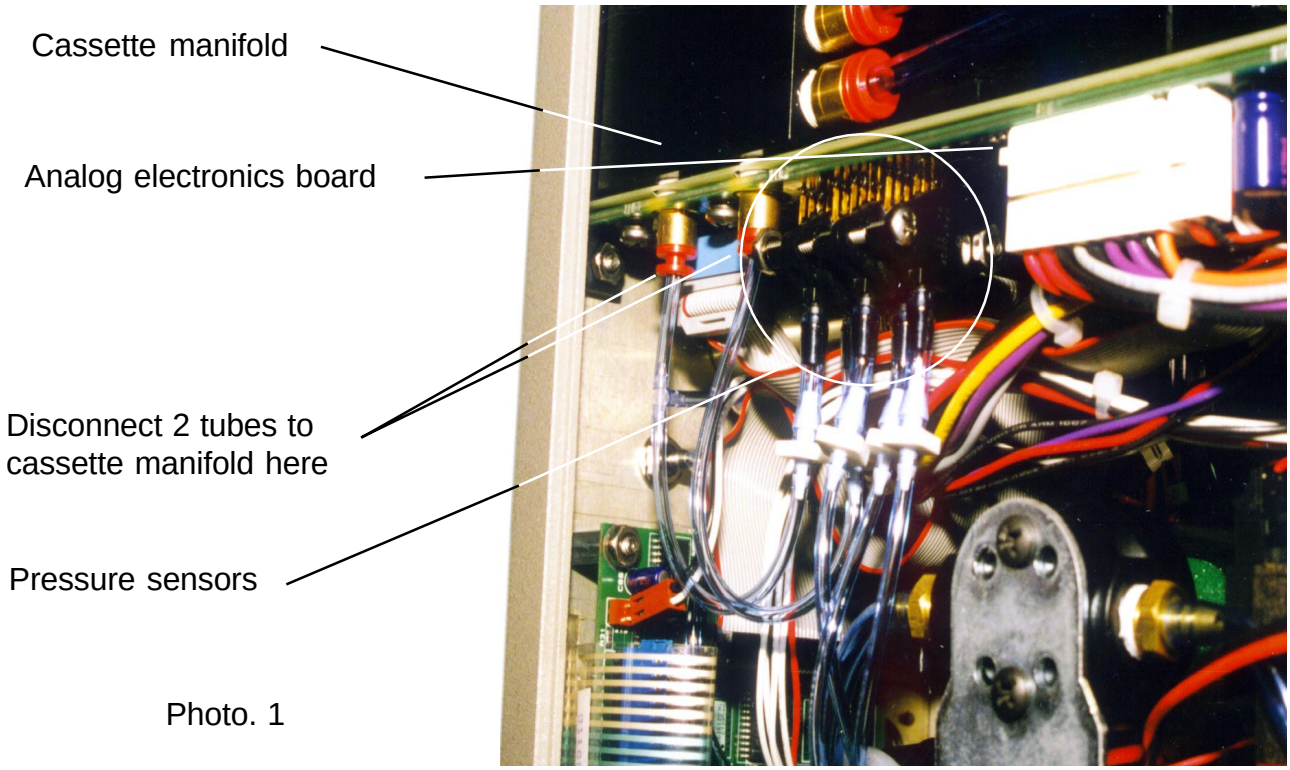


Photo. 1

Analog Electronics Installation

System components that should be installed prior to performing this procedure:

1. light source enclosure
2. cassette housing

System components that are optionally installed prior to performing this procedure:

1. light source fan
2. power supply
3. floppy disk drive
4. back panel

Unless otherwise noted, the system should be placed on it's right side (light source down) to perform his procedure. The system handle should be rotated to stabilize the system in this position.

The analog electronics board is mounted to the side of the cassette housing using seven screws. Each screw has a spacer between the printed circuit board and the side of the cassette housing. A fiberglass insulator protects the back side of the printed circuit board from the side of the cassette manifold. Four of the screws pass through the side of the cassette housing and are retained with nuts and locking hardware. One screw mounts into a countersunk hole in the inside of the cassette housing, passes through the printed circuit board, and is retained by a nut and locking hardware on top of the printed circuit board. The final two screws attach into the side of the cassette manifold. The insulator has holes that the spacers fit into. This allows the spacers to contact the printed circuit board on one side and the side of the cassette enclosure on the other.

1. Place fiberglass insulator onto the side of the cassette housing. Align insulator so that mounting holes in the side of the cassette housing center in the mounting spacer holes in the insulator.
2. Insert seven spacers (they're all the same size) into the holes in the insulator. The holes in the spacers should line up with the holes in the side of the cassette housing.
3. Place the analog electronics board onto the spacers. Align the printed circuit board mounting holes, the spacer holes, and the holes in the side of the cassette housing.
4. Insert two #8 screws into the side of the cassette manifold. Do not tighten.
5. Insert one #4 flat head screw through the side of the cassette housing (from the inside), the spacer, and the printed circuit board. Install #4 flat washer and nut onto the end of the screw. Do not tighten.
6. Insert the remaining four #8 screws through the mounting holes in the side of the cassette housing. Install a flat washer then a lock washer onto each screw on top of the printed circuit board. Install a nut onto each screw. Do not tighten.
7. Ensure that all of the spacers are inserted into the holes in the insulator. The insulator should move freely on the spacers. Align the printed circuit board to the back edge of the side of the cassette housing. See fig. 1. Tighten all seven screws.

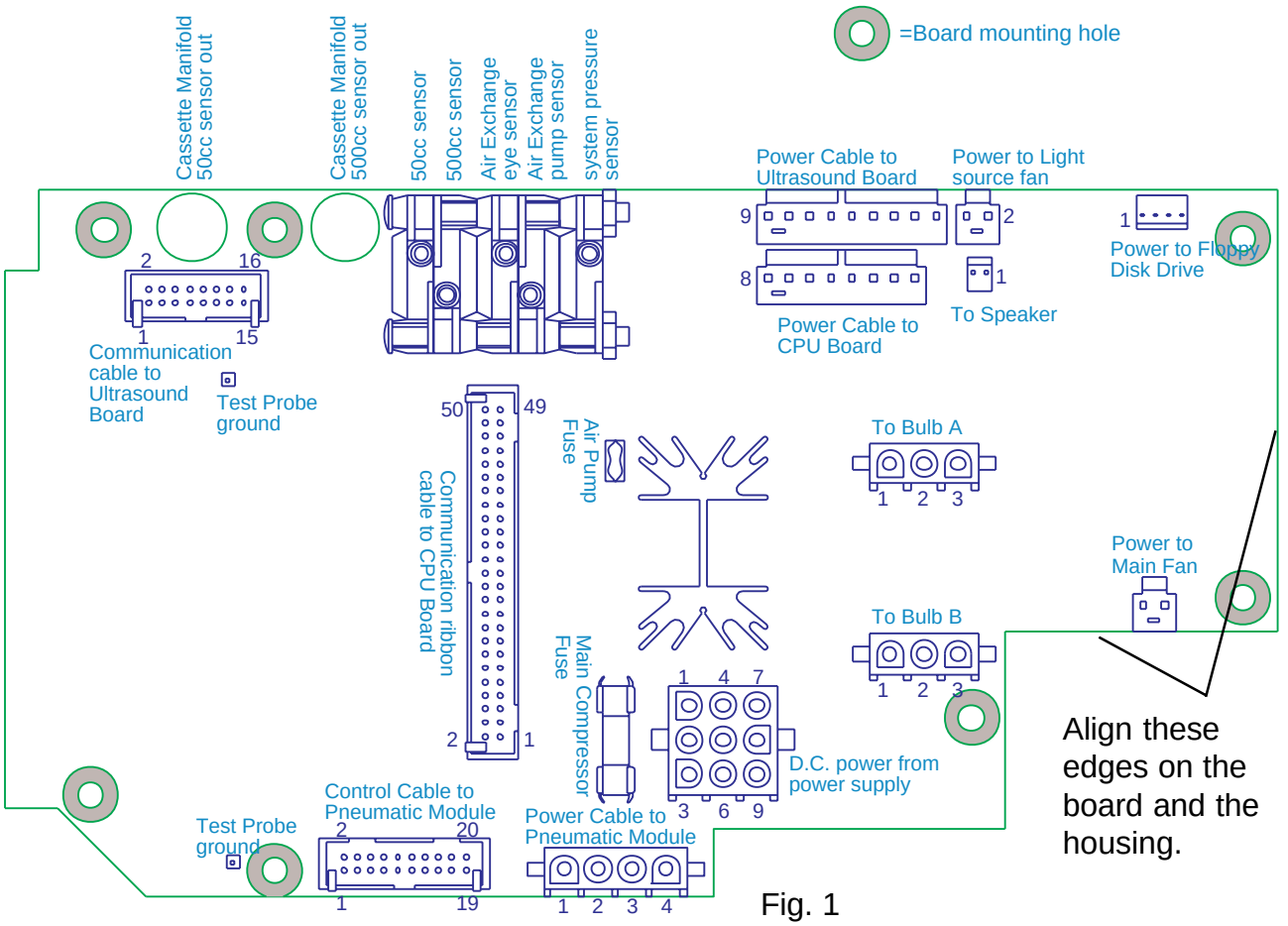
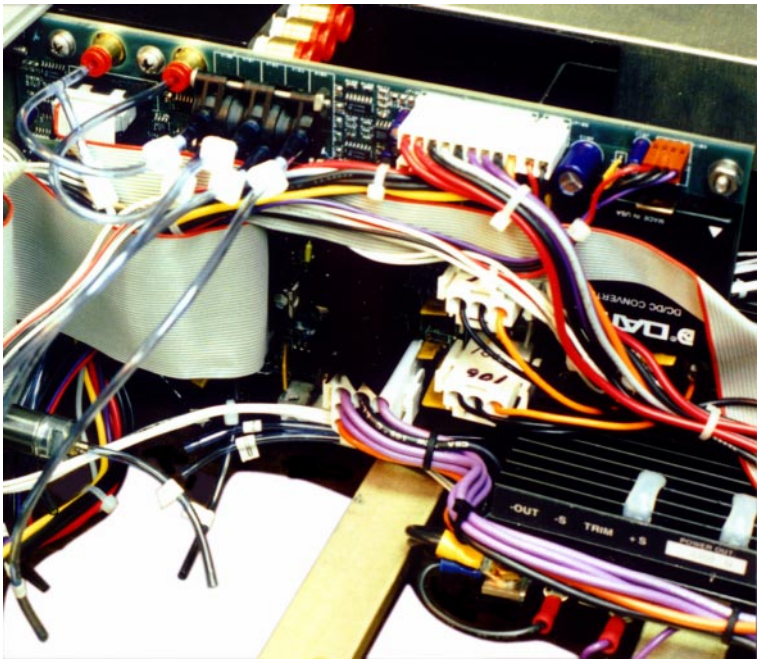

=Board mounting hole
Cassette Manifold 50cc sensor out
Cassette Manifold 500cc sensor out
50cc sensor
500cc sensor
Air Exchange eye sensor
Air Exchange pump sensor
system pressure sensor
Power Cable to Ultrasound Board
Power to Light source fan
Power to Floppy Disk Drive
To Speaker
Power Cable to CPU Board
Communication cable to Ultrasound Board
Test Probe ground
Communication ribbon cable to CPU Board
Air Pump Fuse
Main Compressor Fuse
To Bulb A
To Bulb B
Power to Main Fan
D.C. power from power supply
Control Cable to Pneumatic Module
Power Cable to Pneumatic Module
Test Probe ground
Align these edges on the board and the housing.

Fig. 1
Analog electronics board



Note cable routing

photo. 1

There are thirteen cables connected to the analog electronics board. The two cables that go to the pneumatic module will be connected when the pneumatic module is installed. Of the remaining eleven cables:

Two have ejecter/retainer levers on the printed circuit board connectors. The levers must be moved to the side to insert the cable connector.

Three have catches on the sides that must be squeezed to release the cable connectors. However, inserting the cable connector until it bottoms on the printed circuit board connector is all that is required to connect them.

Six have a pliable catch that doesn't use a release mechanism. To connect the cable, insert the cable connector until it bottoms on the printed circuit board connector.

Cable routing is critical to the correct operation of the system. When they are correctly routed all of the cables stay very close to the analog electronics board. This allows the pneumatic module to move as it operates. Installation of the cables correctly allows the cables to support each other and maintain their position. See fig. 1 and photo. 1.

8. Connect eleven (11) cables to the analog electronics board.

Five air tubes connect to the five air pressure sensors on the analog electronics board. Three of the tubes will be connected when the pneumatic module is installed. The tubes connected to the two pressure sensors located towards the front of the system go to the cassette manifold. The front sensor is connected to the front manifold port. The second sensor is connected to the other manifold port. They can be connected to the cassette manifold by inserting the end of the tube into the hole in the end of the red ring until it bottoms, then pulling the tube from the quick disconnect to seat it. See fig. 1 and photo. 2.

9. Connect two (2) tubes from the cassette manifold.

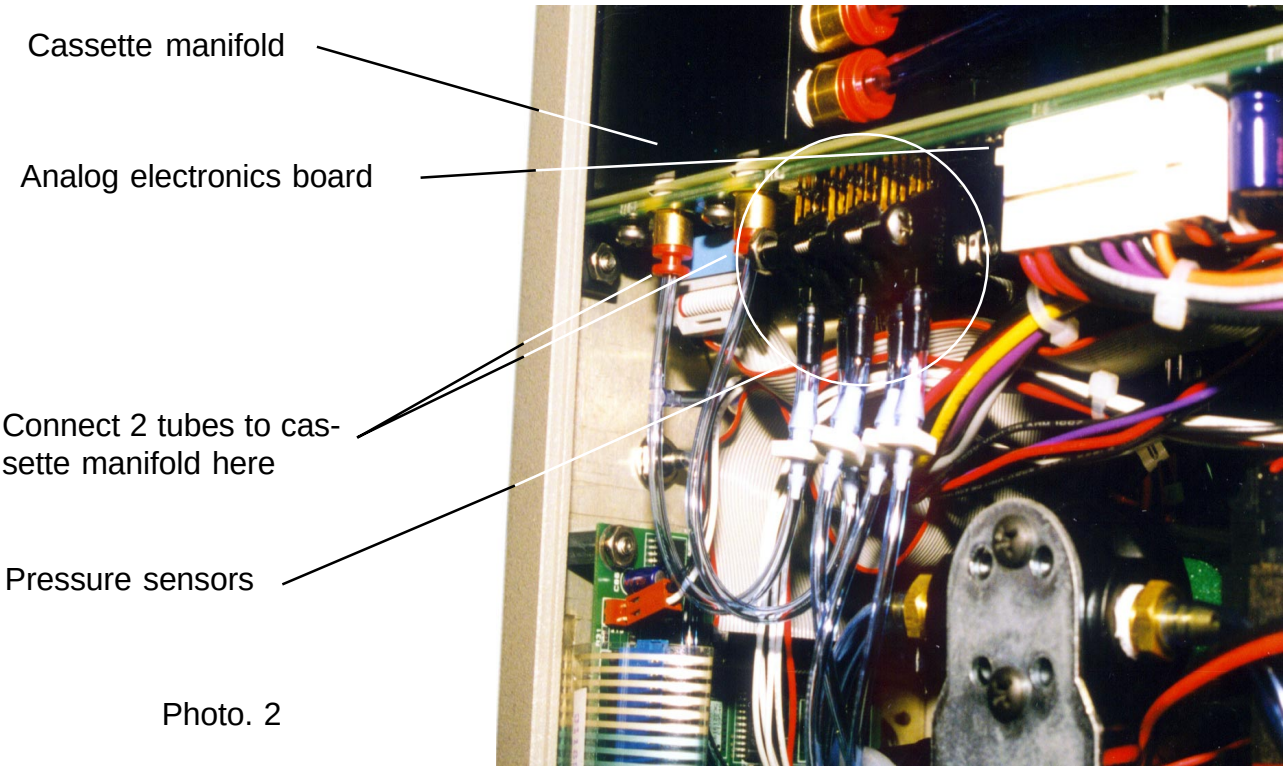


Photo. 2

Tools Required

1. #2 Phillips screwdriver
2. 11/32 inch wrench
3. 1/4 inch wrench

Front Panel Removal

1. Perform System cover removal procedure.

Plastic tubing connects the pneumatic module to various components mounted on the front panel. Each tube has an inline quick disconnect to aid component replacement. There are labels (0-9) on both sides of each quick disconnect to allow reconnection to the correct tubes. The tube is released by depressing the red ring towards the black shell of the quick disconnect. While depressing the red ring, pull the tube from the quick disconnect. To reconnect the tube grasp the black shell of the quick disconnect, insert the appropriate tube into the opening in the end of the red ring until it stops. Tug the tube away from the quick disconnect to seat the tube and ensure proper insertion. See Photo. 1 and Fig. 1

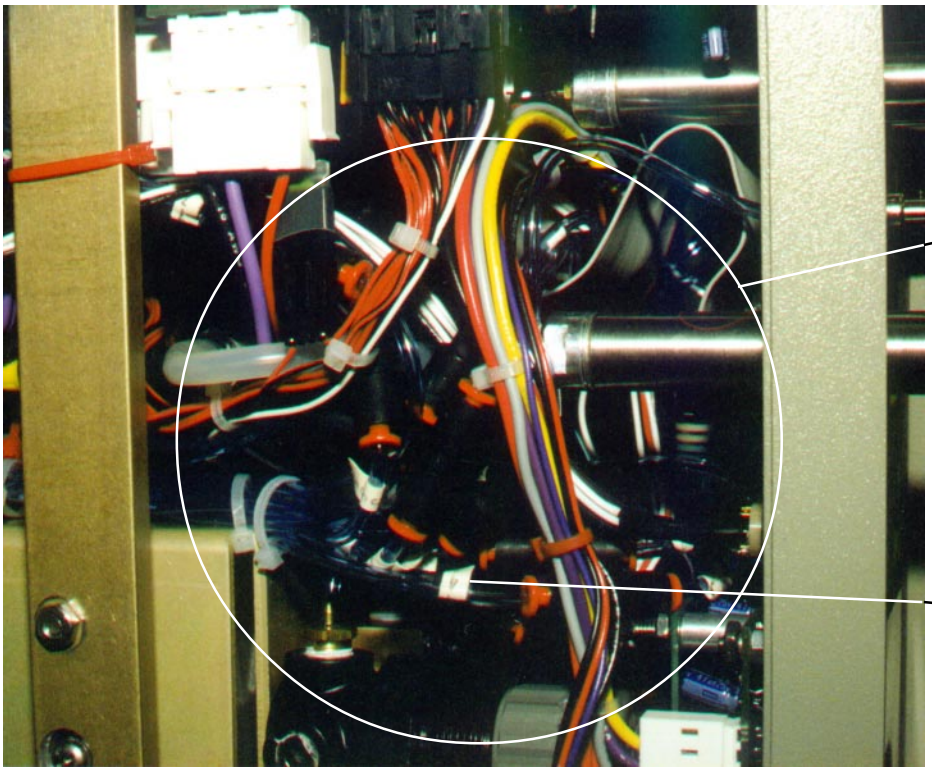


Photo. 1
Bottom front of system

Tube quick disconnect In Line Connector

Fig. 1

2. Disconnect tubes labeled:
   - 1 connects to the aspiration pinch valve
   - 5 connects to the irrigation pinch valve
   - 6 connects to the reflux valve
   - 8 connects to the vitrector output port
   - 9 connects to the air exchange output port

   at the quick disconnects from the pneumatics module.
3. Loosen the front panel as follows:
   a. Remove the 6-32 nuts from the front panel anchor studs which hold the front panel to the Cassette Manifold and the Cassette Lock Knob Bracket. See Photos 2 & 3.
   b. Remove the four screws from the front of the front panel. See Photo. 4.

Photo. 2
View from system top

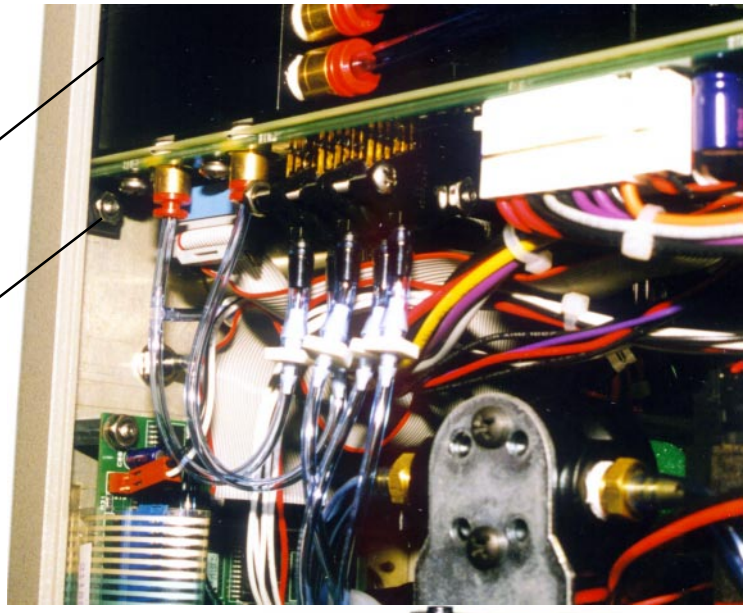


Photo. 3
View from system bottom

Photo. 4

The CPU electronics board is mounted to the front panel. There are six cables that attach to the CPU electronics board. Three of the cables are retained with pliable catches that don't use a release mechanism. The two flat "ribbon" cables have two retainer/ejector levers. The sixth cable attaches to the front panel overlay and doesn't require removal. See Photo 5.

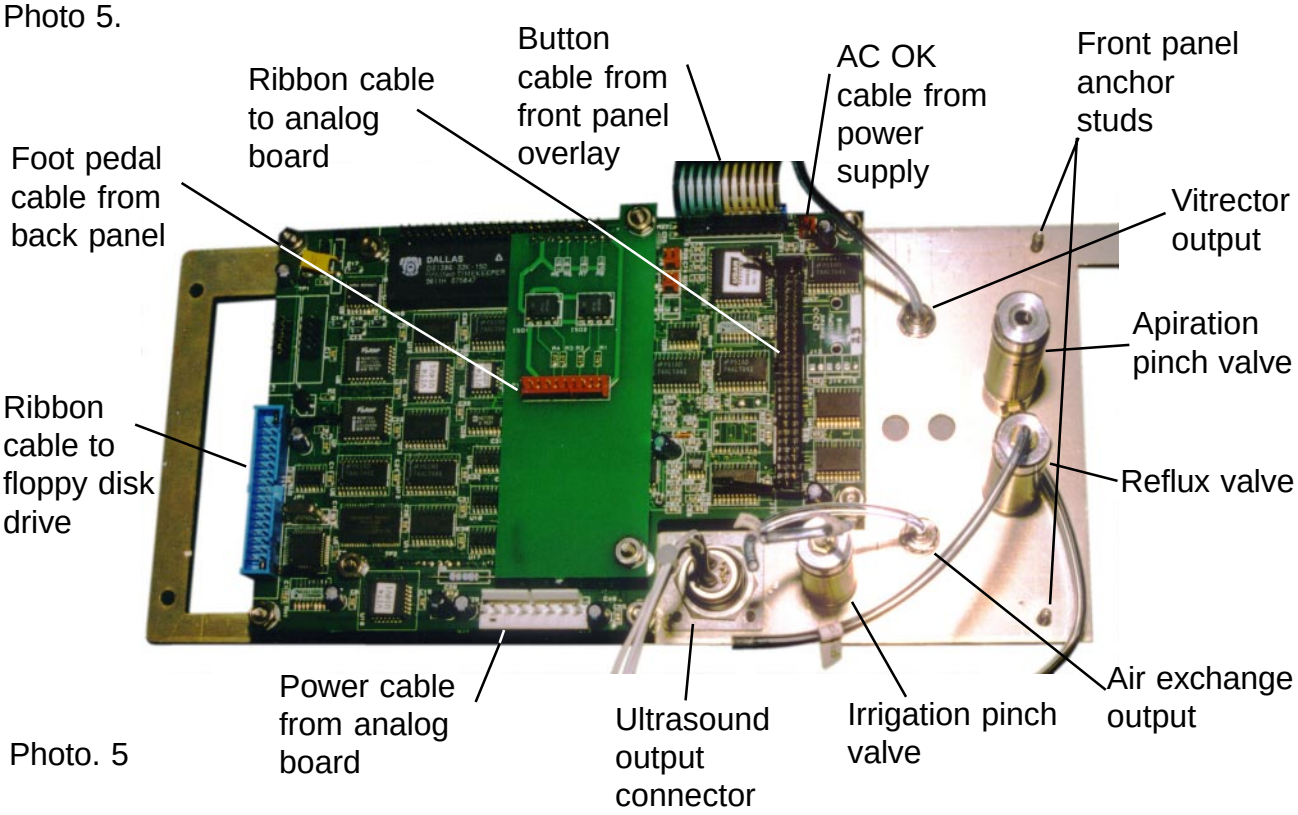

Button cable from front panel overlay
AC OK cable from power supply
Front panel anchor studs
Ribbon cable to analog board
Foot pedal cable from back panel
Vitrector output
Apiration pinch valve
Ribbon cable to floppy disk drive
Reflux valve
Power cable from analog board
Ultrasound output connector
Irrigation pinch valve
Air exchange output

Photo. 5

4. Disconnect five (5) cables from the CPU electronics board
   a. Disconnect AC OK cable by pulling the cable connector away from the printed circuit board connector.
   b. Disconnect foot pedal cable by pulling the cable connector away from the printed circuit board connector.
   c. Disconnect power cable by pulling the cable connector away from the printed circuit board connector.
   d. Move the levers to the side to release and eject the analog electronics board ribbon cable connector from the printed circuit board connector.
   e. Move the levers to the side to release and eject the floppy disk drive ribbon cable connector from the printed circuit board connector.

The ultrasound output cable attaches to the ultrasound output connector (which is attached to the front panel) on one end and the ultrasound electronics board (which is attached to the back panel) on the opposite end. The cable splits into two cables prior to the ultrasound electronics board. Each cable has a separate connector, that is retained by a catch in the connector. The catch must be depressed to release the connector from the printed circuit board connector.

5. Disconnect two (2) ultrasound output cables from the ultrasound electronics board. See Photo. 6 and Photo. 7.

Release catches and disconnect both ultrasound output cables from the printed circuit board.

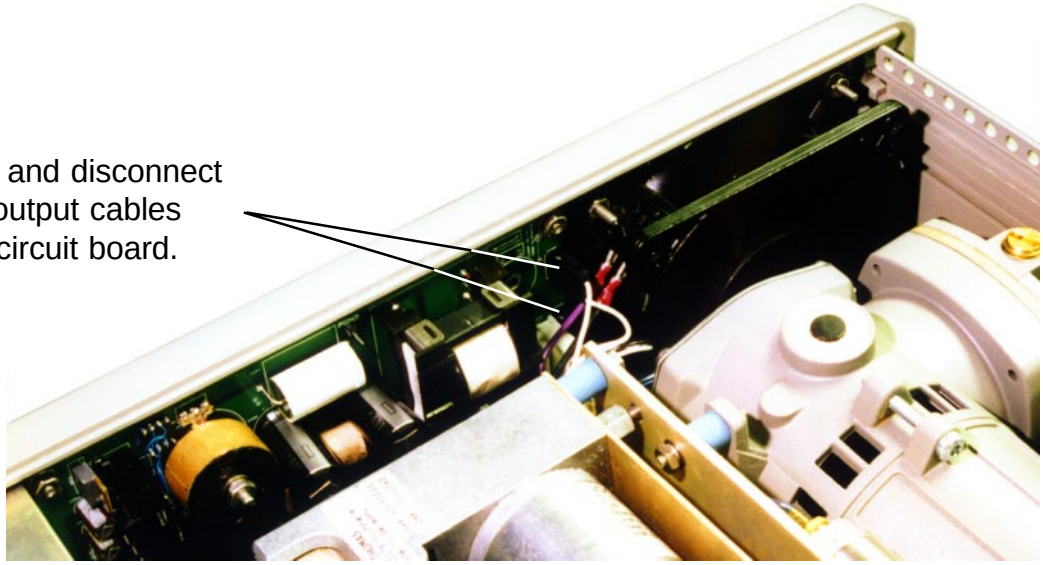
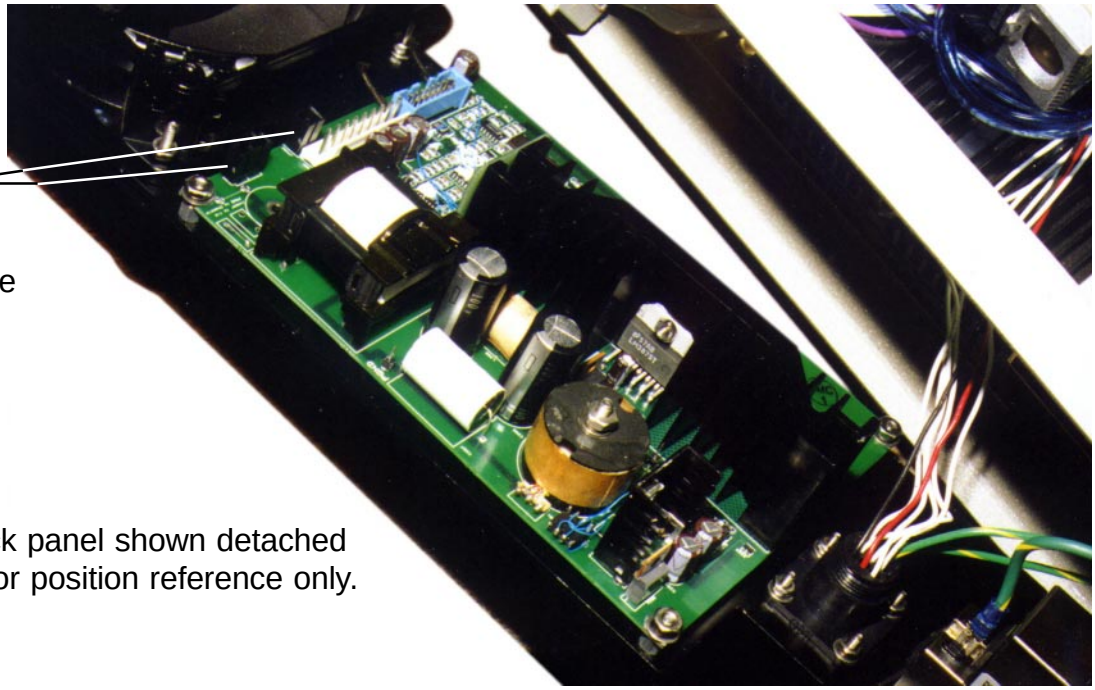


Photo. 6



Ultrasound output cable connectors are located here.

Photo. 7
System back panel shown detached for connector position reference only.

6. Pull the ultrasound output cable out from under the system power supply and structural rails. Untangle the cable from other system components until it hangs freely from the ultrasound power output connector on the front panel.
7. Carefully move the front panel forward.
8. Check for tangled tubes or cables and cables that may have been inadvertantly missed during prior steps.
9. Pull the front panel away from the system.

Tools Required

1. #2 Phillips Screwdriver
2. 5/16 Inch open end wrench
3. Refer to the tool requirement for all procedures referenced in this procedure.

Front Panel Installation

System components that should be installed prior to performing this procedure:

1. light source enclosure
2. floppy disk drive
3. cassette housing
4. analog electronics board

System components that are optionally installed prior to performing this procedure:

1. pneumatic module
2. light source fan
3. power supply
4. back panel

The system's front panel has various components attached to it. The following components should be installed onto the front panel prior to performing this procedure:

1. aspiration, irrigation, and reflux pinch valves
2. CPU electronics board
3. vitrector output port
4. air exchange output port
5. ultrasound output connector and cable

1. Place the front panel against the front bezel of the chassis. Ensure that the anchor studs are inserted into their mounting holes. See photos 1-4.
2. Attach the front panel as follows:
   a. Install the four screws into the front of the front panel. See Photo. 1.
   b. Install the nuts onto the front panel anchor studs which hold the front panel to the Cassette Manifold and the Cassette Lock Knob Bracket. See Photos 2 & 3.

Photo. 2
View from system bottom

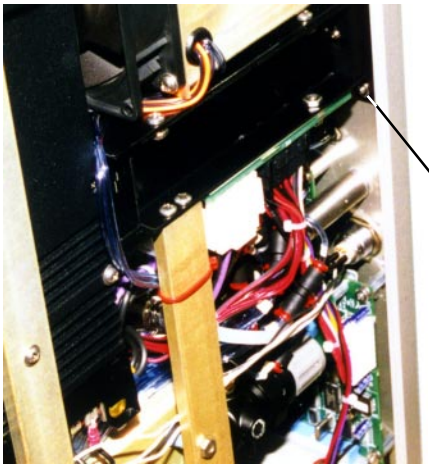


Photo. 1

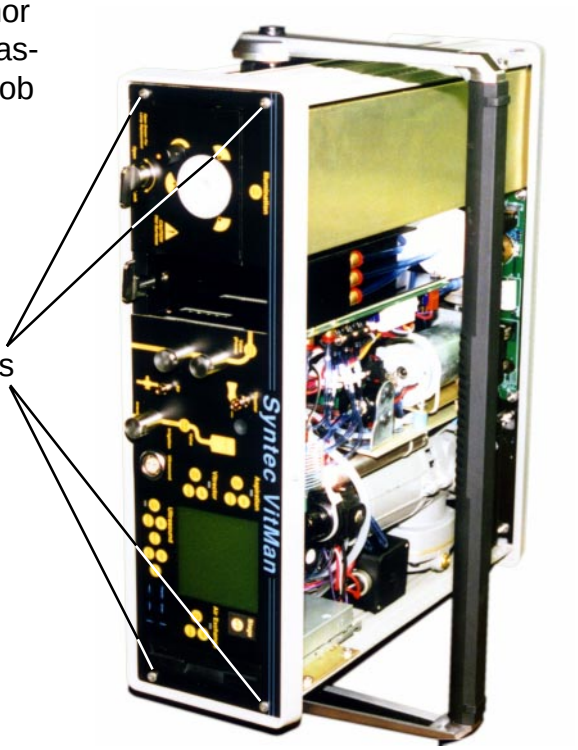
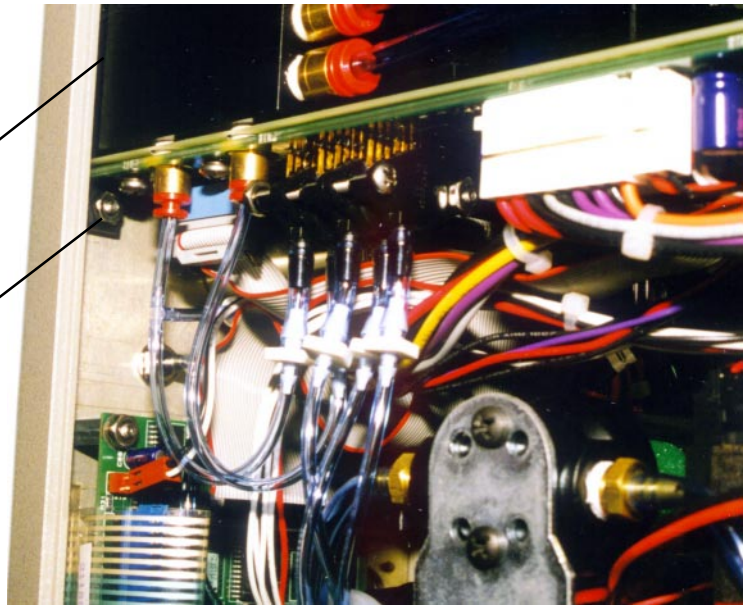


Photo. 3
View from system top



There are six cables that attach to the CPU electronics board. The button cable should already attach the CPU electronics board to the front panel overlay. A ribbon cable connects the CPU electronics board to the floppy disk drive. It should fold to lay close to the floppy disk drive and the CPU electronics board. The power cable that goes to the analog electronics board should be routed along the bottom of the front panel until it is near the analog electronics board. Then it will go towards the top of the system until it nears the top of the analog electronics board. It then goes toward the back of the system to connect to the analog electronics board. A ribbon cable connects the CPU electronics board to the analog electronics board. It should be folded towards the aspiration pinch valve. Whenever possible, other cables should be routed between this ribbon cable and the pinch valves to help keep them in place. The AC OK and the foot pedal cables should be routed to go against the analog electronics board towards the back of the system. Routing of these cables is important to the correct functioning of the system. Each of these cables should stay very close to the analog electronics board. It is important that they do not protrude into the space occupied by the pneumatic module. See photos 4&5.

The two flat ribbon cables' connectors have retainer/ejector levers on the printed circuit board connectors. The levers need to be moved to the side to allow the cable connector to engage the printed circuit board connector. The levers will move to lock the connector into place when the cable connector is fully seated. The other cables are retained with pliable catches that don't use a release mechanism. To connect these cables push the cable connector onto the printed circuit board connector until it bottoms.

3. Connect five (5) cables to the CPU board. See photos 4&5.

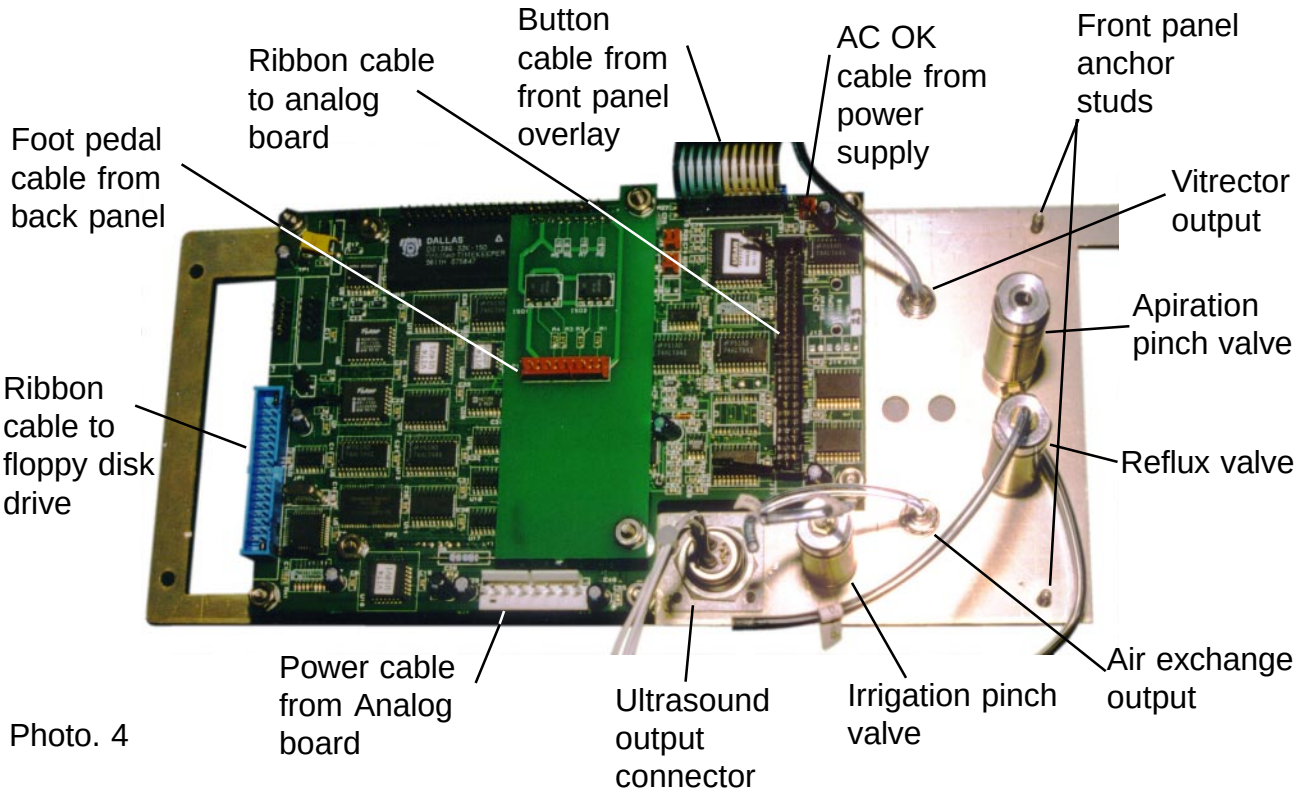

Button cable from front panel overlay
Ribbon cable to analog board
AC OK cable from power supply
Front panel anchor studs
Foot pedal cable from back panel
Vitrector output
Apiration pinch valve
Ribbon cable to floppy disk drive
Reflux valve
Power cable from Analog board
Ultrasound output connector
Irrigation pinch valve
Air exchange output

Photo. 4

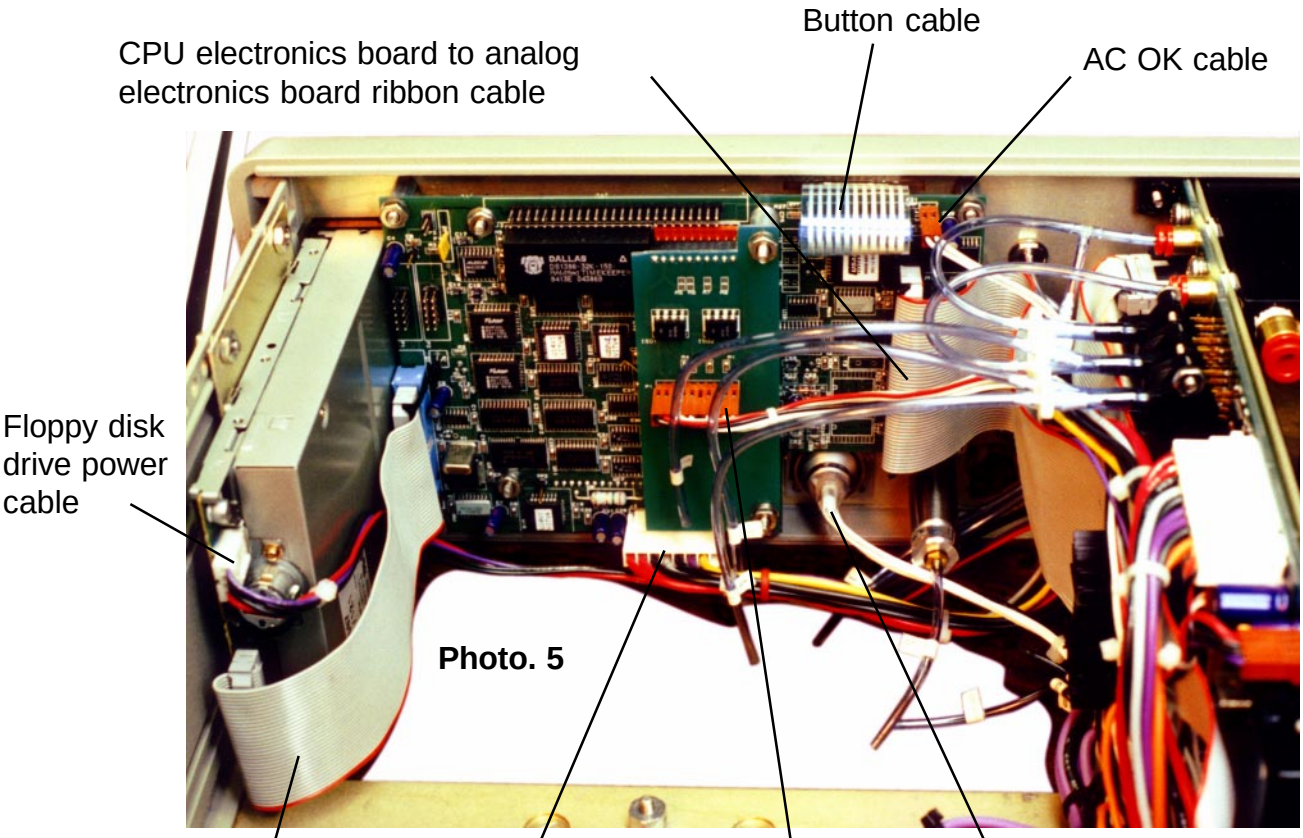
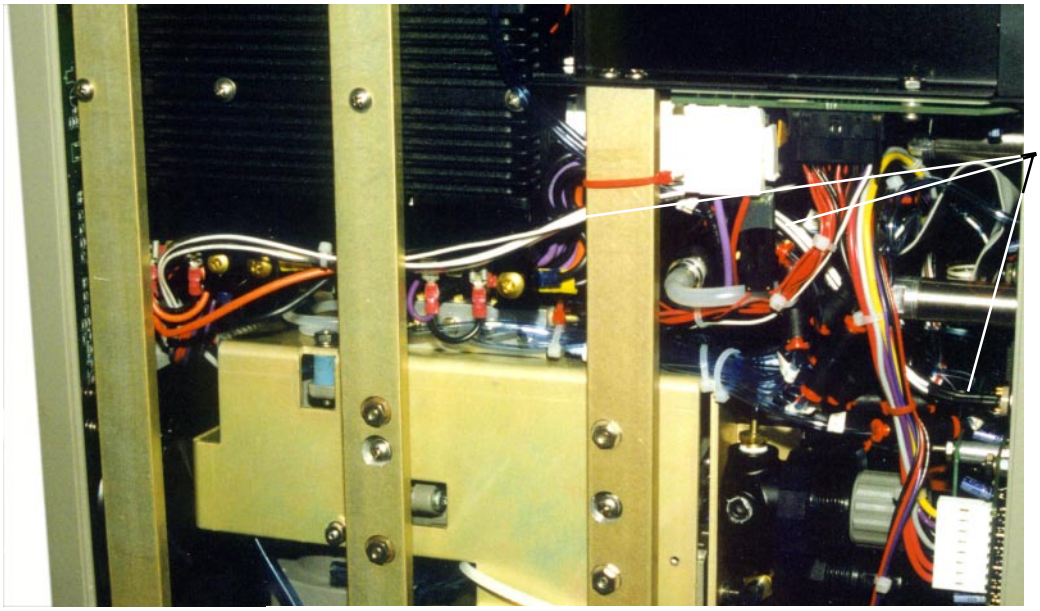
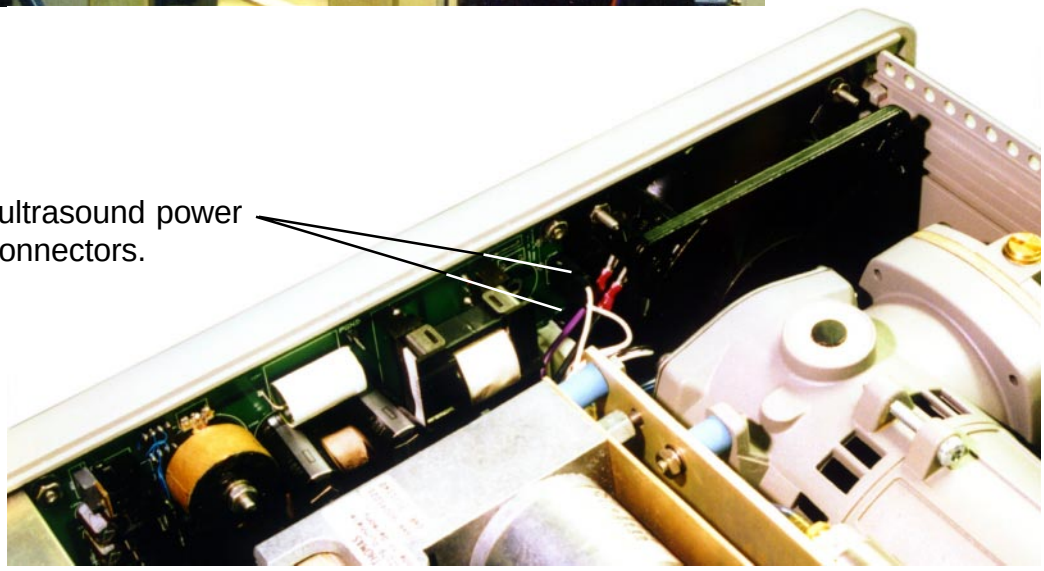

Button cable
CPU electronics board to analog electronics board ribbon cable
AC OK cable
Floppy disk drive power cable
CPU electronics board to floppy disk drive ribbon cable
CPU electronics board power cable
Foot pedal cable
Ultrasound power output cable

Photo. 5



Route cable as shown.

Photo. 6



Connect both ultrasound power output cable connectors.

Photo. 7

The ultrasound power output cable connects to the ultrasound electronics board on one end and the ultrasound power output connector (mounted to the front panel) on the other end. The cable should be routed across the bottom of the system. Starting at the front panel it should go towards the end of the power supply. From there it should go directly towards the back of the system, above the structural rails and below the connection wires on the dc output end of the power supply. At the back of the power supply, the cable should turn towards the top of the system. If the back panel is installed, the two connectors on the end of the cable should be inserted into the printed circuit board connectors until the connector catch engages. See Photos 6,7,&8.

4. Route the ultrasound output cable to the back of the system. See photo. 6.
5. If the back panel is installed, connect two (2) ultrasound power output cable connectors to the ultrasound electronics board. See Photos 7&8.

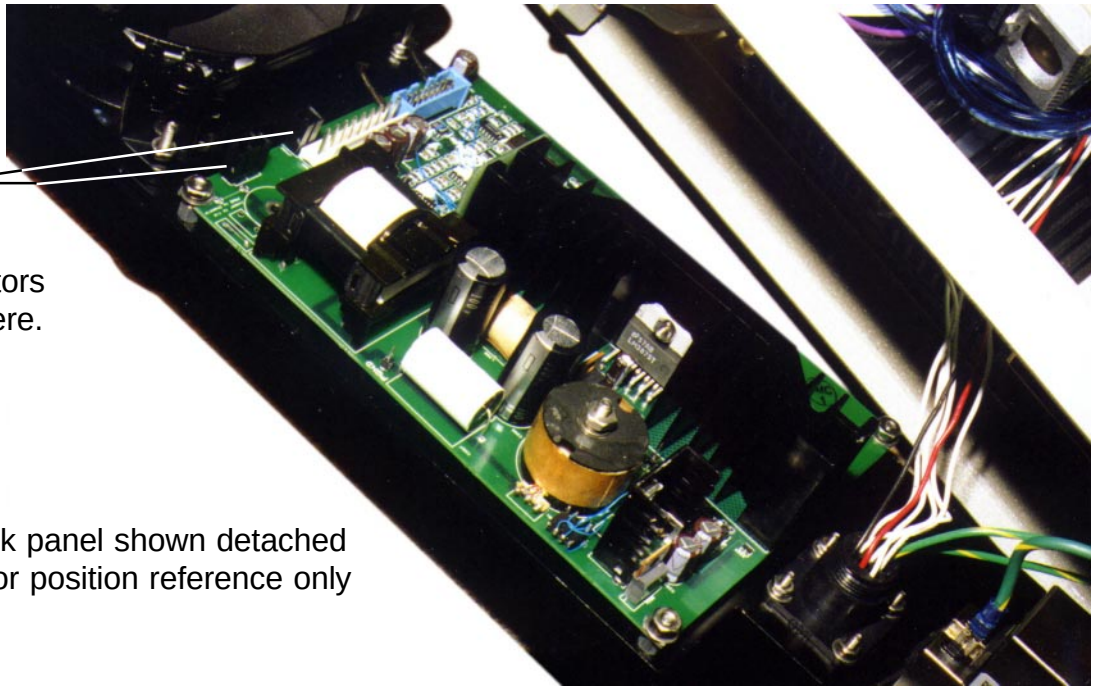


Photo. 8
System back panel shown detached for connector position reference only

Plastic tubing connects the pneumatic module to various components mounted on the front panel. Each tube has an inline quick disconnect to aid component replacement. There are labels (0-9) on both sides of each quick disconnect to allow reconnection to the correct tubes. The tube is released by depressing the red ring towards the black shell of the quick disconnect. While depressing the red ring, pull the tube from the quick disconnect. To reconnect the tube grasp the black shell of the quick disconnect, insert the appropriate tube into the opening in the end of the red ring until it stops. Tug the tube away from the quick disconnect to seat the tube and ensure proper insertion. See photo. 9 and fig. 1

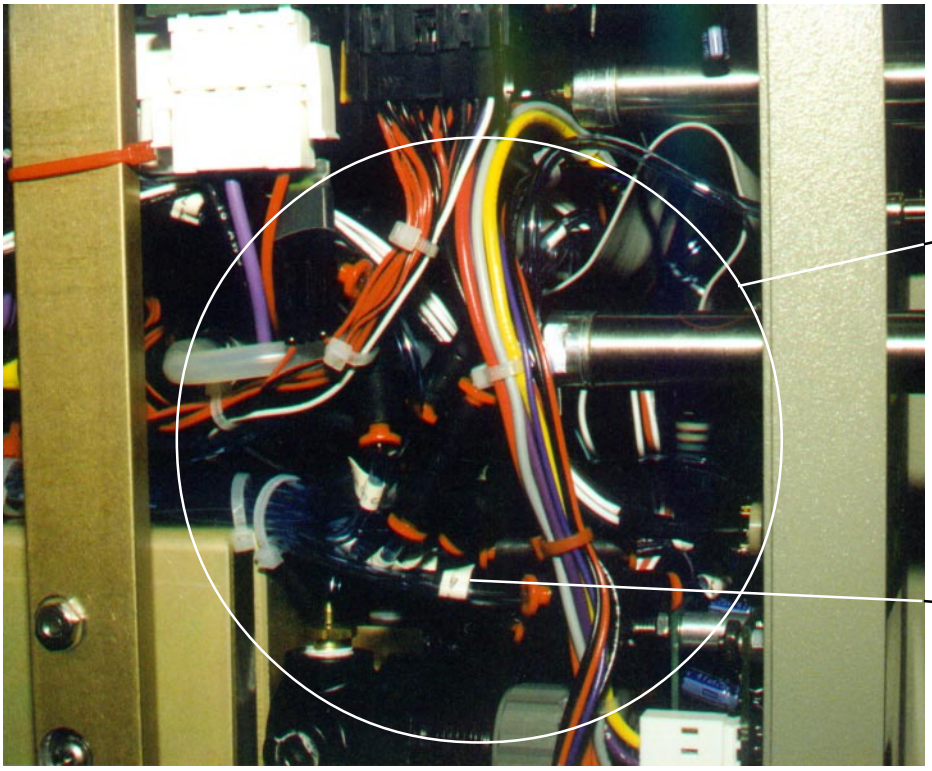
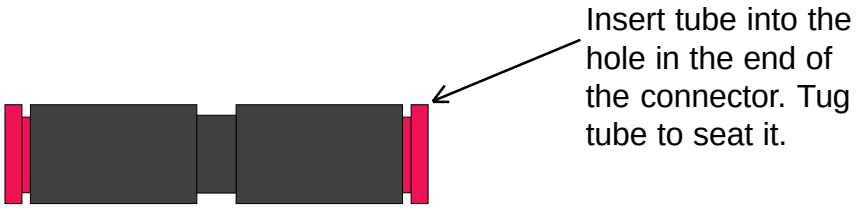


Photo. 9
Bottom Front of system



Tube quick disconnect In Line Connector

Fig. 1

2. If the pneumatic module is installed, connect tubes labeled:
   - 1 connects to the aspiration pinch valve
   - 5 connects to the irrigation pinch valve
   - 6 connects to the reflux valve
   - 8 connects to the vitrector output port
   - 9 connects to the air exchange output port

   at the quick disconnects from the pneumatics module.

Tools Required

1. #2 Phillips Screwdriver
2. 5/16 Inch open end wrench

CPU Electronics Removal

1. Perform the System cover removal procedure.
2. Perform the Front panel removal procedure.

The CPU electronics board is mounted to the front panel using five threaded studs. Each stud has a spacer between the printed circuit board and the front panel. A nut and locking hardware attaches to the stud on top of the printed circuit board. See photo. 1.

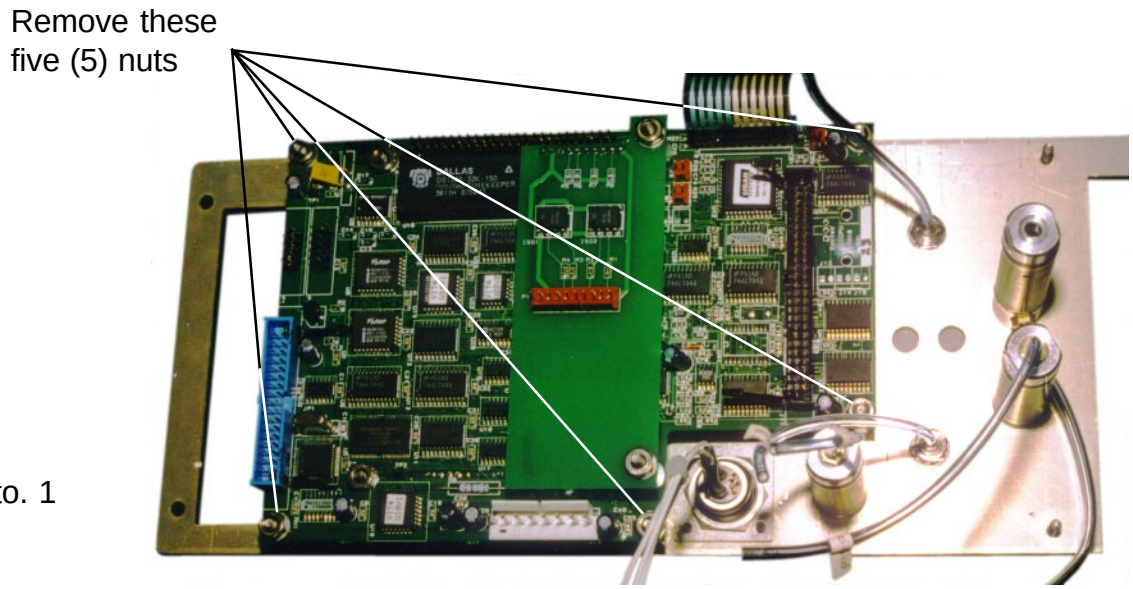


Photo. 1

3. Unscrew the five (5) nuts from the studs attaching the CPU electronics board to the front panel.
4. Pull the CPU electronics board off of the studs. Set the hardware to the side to reuse.

Tools Required

1. 5/16 inch wrench or nutdriver
2. Refer to the tool requirement for all procedures referenced in this procedure.

CPU Electronics Installation

The CPU electronics board is mounted to the front panel of the system. It should be installed with the front panel removed from the system. It is mounted to the front panel using five threaded studs. Each stud has a spacer between the printed circuit board and the front panel. A nut and locking hardware attaches to the stud on top of the printed circuit board. See photo. 1.

Install these five (5) nuts

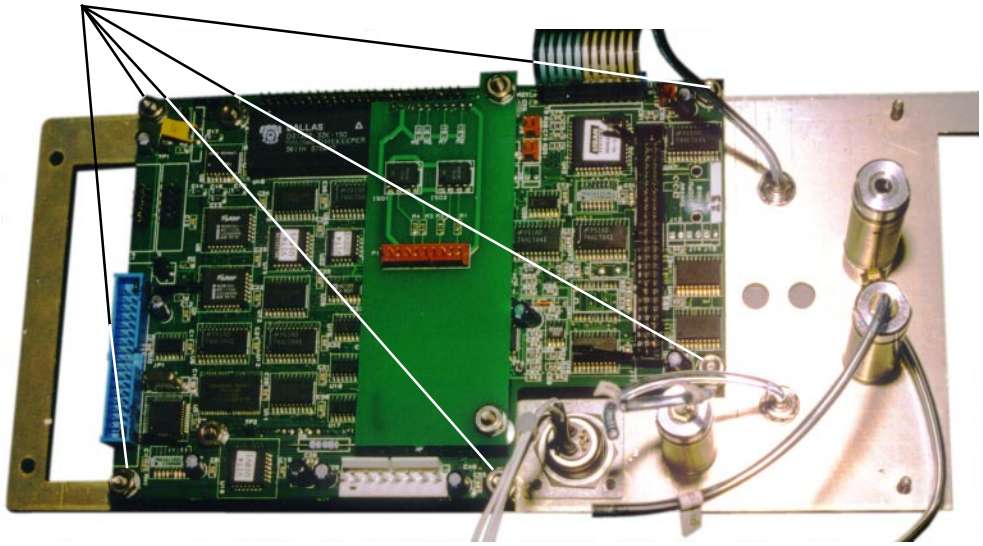


Photo. 1

1. Install the spacers onto the front panel studs, if they aren't already there.
2. Ensure that both the display screen on the CPU electronics board and the inside of the display window on the front panel overlay are clean and free of dust and fingerprints.
3. Place the CPU electronics board onto the studs.
4. Install the locking hardware onto the studs.
5. Screw the five (5) nuts to the studs attaching the CPU electronics board to the front panel.

The CPU electronics board has light emiting diodes (LEDs) that extend to the front panel. These LEDs are visible from the front of the front panel. They provide the surgical function status lights. In order to have the correct appearance the LEDs need to be aligned with the clear windows in the front panel overlay. If necessary, gently use a pair of needle nose pliers to bend the LED to align it with the window in the overlay. The top of the LED should fill the window when viewed from the front of the front panel.

6. Align status LEDs.

Tools Required

1. 5/16 inch wrench or nutdriver
2. Needle nose pliers

Back Panel Removal

1. Perform the System cover removal procedure.
2. Disconnect the two power wires from the fan. See Photo 1.
3. Lay the system on it's bottom.

Purple wire towards the back,
Black wire towards the front.
Use needle nose pliers to disconnect and connect.

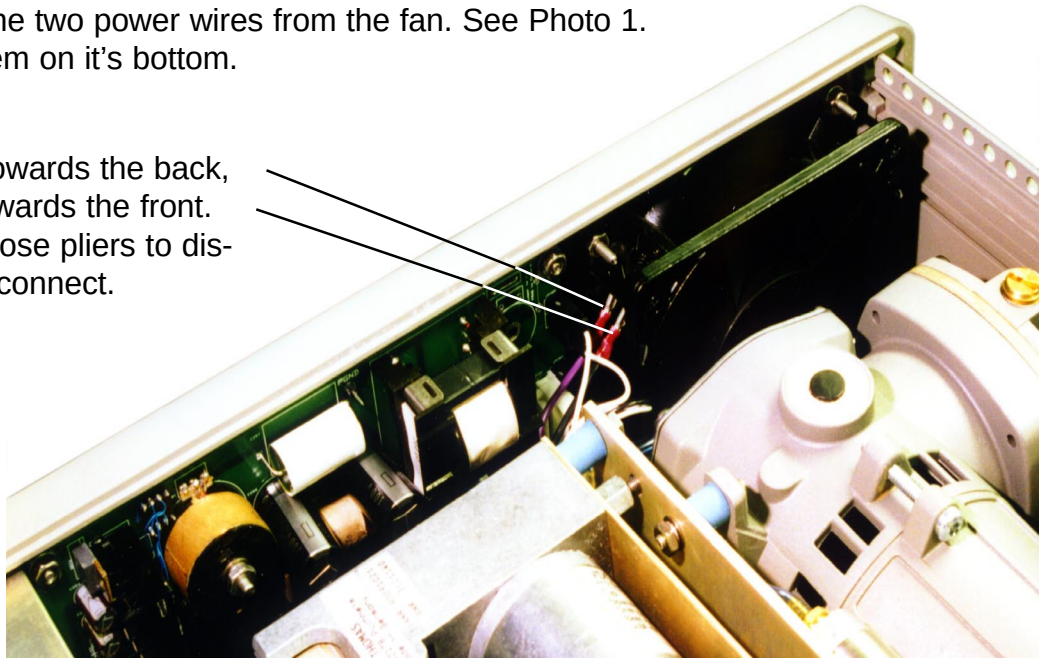
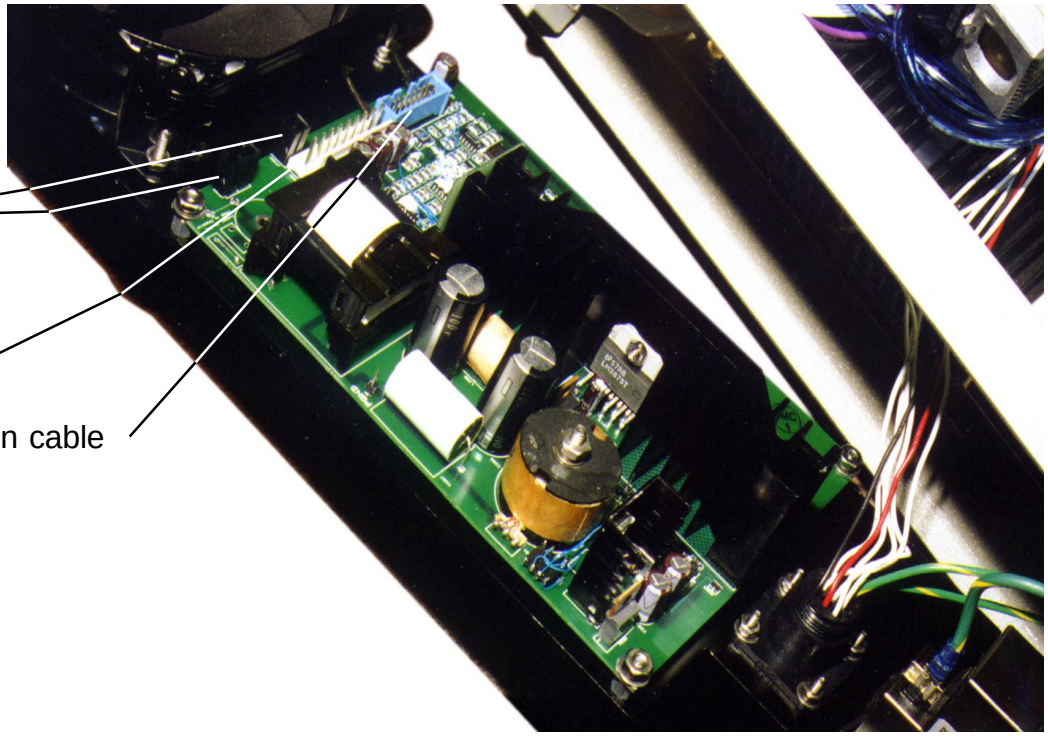


Photo.1

The ultrasound electronics board is mounted to the back panel. There are four cables that attach to the ultrasound board. The two small cables have release catches that must be depressed during disconnect. The power cable is retained with a pliable catch that doesn't use a release mechanism. The flat "ribbon" cable has two retainer/ejector levers. See Photo 2.

Photo. 2



4. Remove the two screws holding the back panel to the chassis (the screws were installed during the system cover removal procedure). Pull the back panel slightly away from the chassis to allow access to the cables.
5. Disconnect the two small cables by depressing the release catches and removing the cable connectors from the printed circuit board connectors.
6. Disconnect the power cable by pulling the cable connector away from the printed circuit board connector.
7. Move the levers to the side to release and eject the ribbon cable connector from the printed circuit board connector.

All of the cables should now be disconnected from the ultrasound electronics board.

The electrical power for the system enters through a power entry module that houses the system power switch and main system fuse(s). The wires from the power entry module use spade style connectors that can be disconnected by pulling the wire connector away from the module connector. The foot pedal connector is mounted to the back panel using four screws with appropriate nuts and locking hardware. See photo. 3.

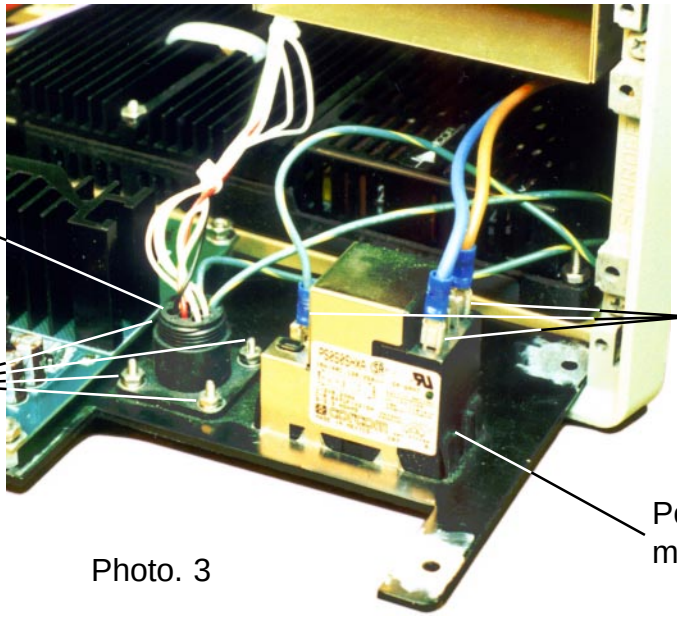


Photo. 3

8. Disconnect the three (3) system power wires from the power entry module.
9. Disassemble the foot pedal connector from the back panel.

Tools Required

1. #2 Phillips screwdriver
2. Needle nose pliers
3. #1 Phillips screwdriver
4. 1/4” nutdriver or wrench
5. Refer to the tool requirement for all procedures referenced in this procedure.

Back Panel Installation

System components that should be installed prior to performing this procedure:

1. light source enclosure and fan
2. power supply
3. cassette housing
4. analog electronics board

System components that are optionally installed prior to performing this procedure:

1. pneumatic module
2. floppy disk drive
3. front panel

The system back panel has various components attached to it. The following components should be installed onto the back panel prior to performing this procedure:

1. system fan and filter housing
2. ultrasound electronics board
3. power entry module

The foot pedal connector is mounted to the inside of the back panel. It should be rotationaly oriented so that the two green/ w yellow striped wires are toward the bottom of the back panel. The foot pedal connector is retained to the back panel by four screws. Each of these screws passes through the back panel, then the mounting flange of the foot pedal connector. A flat washer, lock washer, then a nut is installed onto the end of each screw to hold the foot pedal connector in place. See photo. 1.

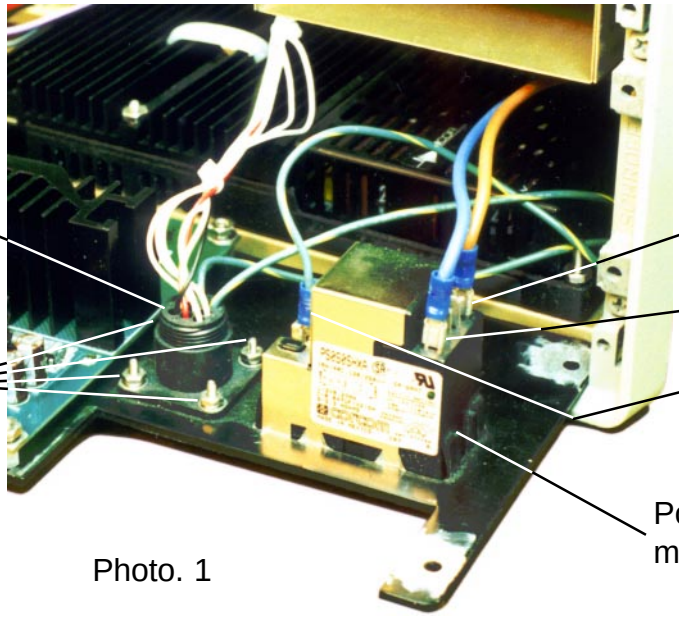

Foot pedal connector
Install four screws.
Note rotational position of connector.
Connect the brown wire to “A”.
Connect the blue wire to “D”.
Connect the green w/yellow wire here.
Power entry module

Photo. 1

The foot pedal cable starts at the back panel (after installation of the connector onto the back panel). It should be routed on the top of the power supply towards the back of the analog electronics board. It should then go up and across the analog electronics board (very close to the board) towards the front panel of the system. It is important that the cable stay close to the power supply and analog electronics board in order to clear the pneumatic module and make room for the hydrophobic filters.

1. Assemble the foot pedal connector to the back panel.

The wires connecting the power input module to the power supply and chassis ground are terminated with connectors that mate with the spade lugs on the power input module. The blue wire should be connected to the lug marked “D”, on the switch side of the power input module towards the top. The brown wire should be connected to the lug marked “A”, on the switch side of the power input module towards the bottom. The green w/ yellow striped wire should be connected to the only unmarked lug on the power input module towards the inside of the system. The wires should fold into the space between the power supply and the light source air duct when the back panel is installed. See photo. 1.

2. Connect the three (3) system power wires to the power entry module.

Two cables connect the ultrasound electronics board to the analog electronics board. One cable connects power to the system fan from the analog electronics board. All three cables should already be connected to the analog electronics board. Routing of these cables is important to the correct functioning of the system. Each of these cables should stay very close to the analog electronics board. It is important that they do not protrude into the space occupied by the pneumatic module. In the span between the analog electronics board and the back panel the cables should be routed on top of the power supply, under the vacuum pump and tubing of the pneumatics module. Near the back panel the cables should stay very close to the ultrasound electronics board. See photos 2-4.

Purple wire towards the back,
Black wire towards the front.
Use needle nose pliers to dis-
connect and connect.

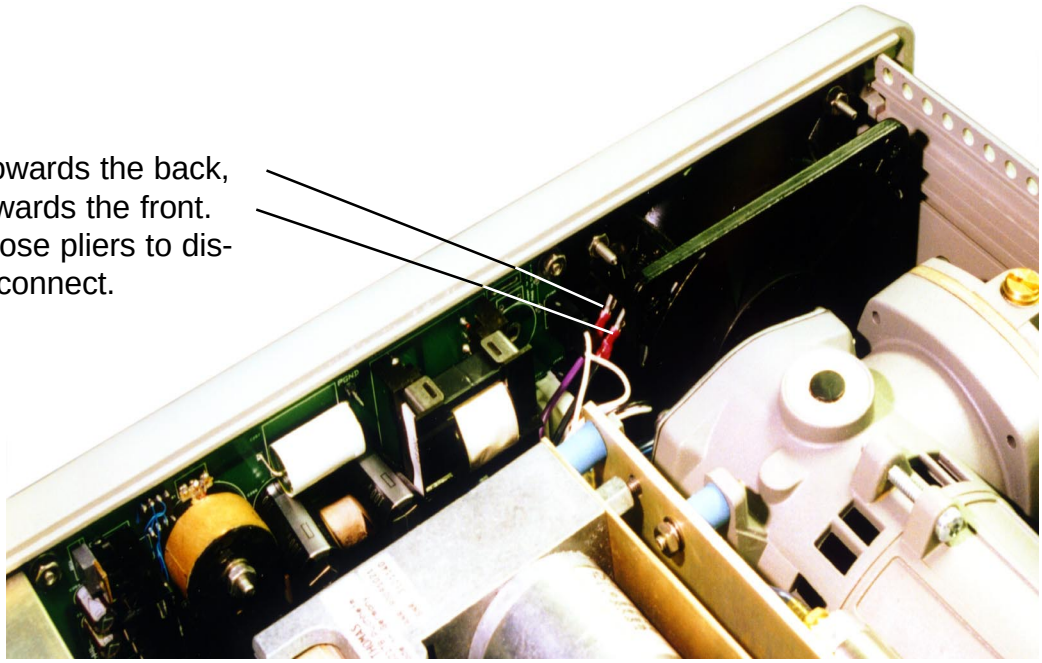
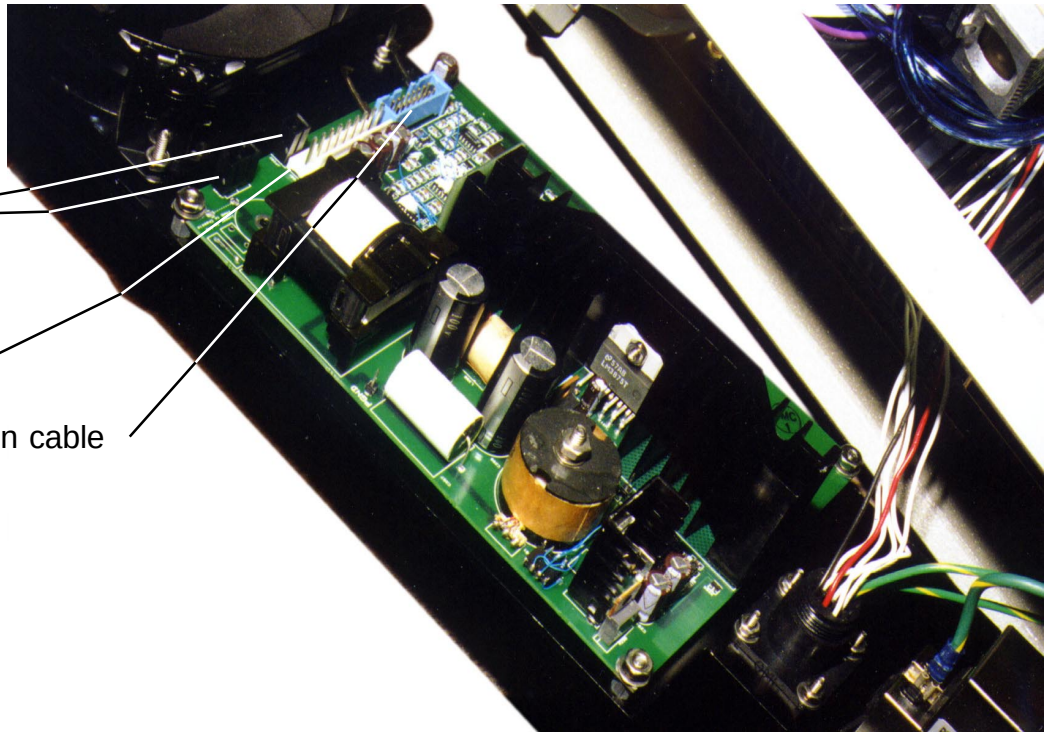


Photo.2

Photo. 3



The ultrasound power output cable starts at the ultrasound electronics board, with two connectors. It should be routed directly toward the bottom of the system, then towards the front of the system, under the end of the power supply but on top of the structural rails. See photo. 4.

3. Install two screws to hold the back panel to the chassis.
4. Lay the system on it's left side.

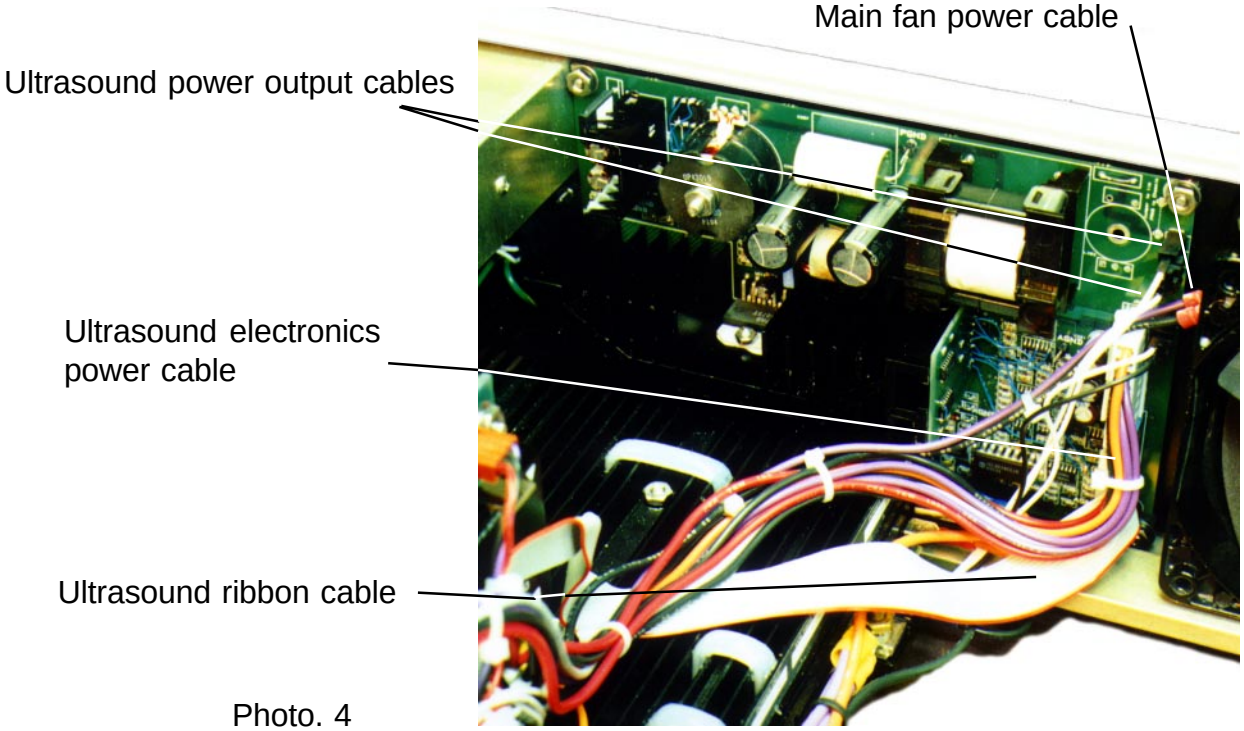


Photo. 4

5. Install the ribbon cable connector into the printed circuit board connector. The printed circuit board connector has two retainer/ejector levers. The levers must be moved to the side to allow installation of the cable connector. The levers will engage the cable connector when it is fully seated into the printed circuit board connector.
6. Connect the power cable to the printed circuit board connector. Insert the connector until it bottoms on the printed circuit board connector.
7. Connect the two small connectors of the ultrasound output cable to the printed circuit board. Insert far enough to engage the connector catches.
8. Connect the two power wires to the fan.

Tools Required

1. #2 Phillips screwdriver
2. Needle nose pliers
3. #1 Phillips screwdriver
4. 1/4 inch nutdriver or wrench

Ultrasound Electronics Removal

1. Perform the system cover removal procedure.
2. Perform the back panel removal procedure to step 7.

All of the cables should now be disconnected from the ultrasound electronics board.

The ultrasound electronics board is mounted to the back panel using four screws. Each screw has a spacer between the printed circuit board and the back panel. A nut and locking hardware attaches to the screw on top of the printed circuit board. See Photo. 1.

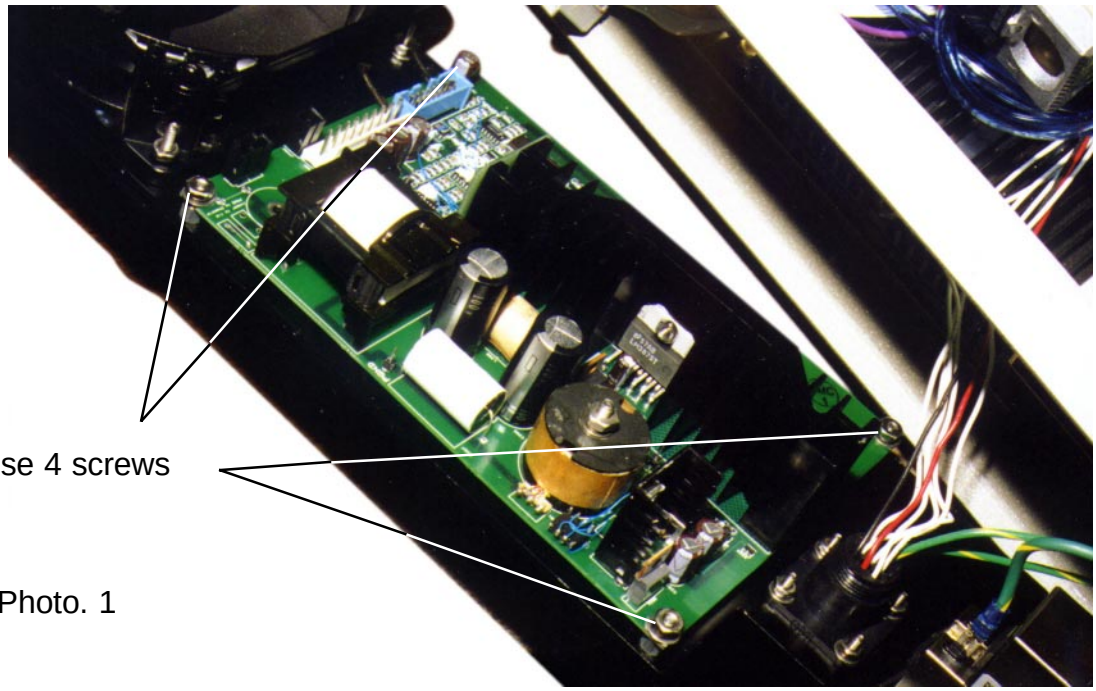


Photo. 1

3. Unscrew the four (4) nuts from the screws attaching the ultrasound electronics board to the back panel.
4. Remove the screws from the back panel. Set the hardware to the side to reuse.

Tools Required

1. #2 Phillips screwdriver
2. 5/16 inch wrench or nutdriver
3. Refer to the tool requirement for all procedures referenced in this procedure.

Ultrasound Electronics Installation

The ultrasound electronics board is mounted to the back panel of the system. The back panel should be removed from the system for installation. It is mounted to the back panel using four screws. Each screw has a spacer between the printed circuit board and the back panel. Locking hardware and a nut attaches to the screw on top of the printed circuit board. See Photo. 1.

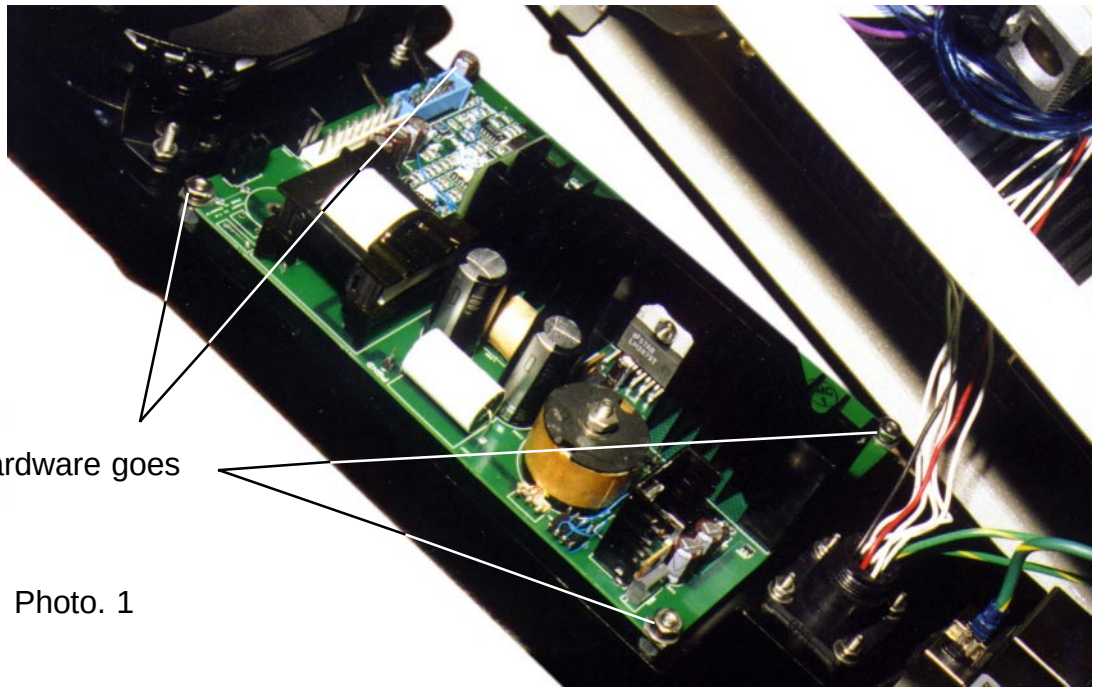


Photo. 1

1. Insert the four screws into the back panel.
2. Install the four spacers onto the screws on the inside of the back panel.
3. Place the ultrasound electronics board onto the screws on top of the spacers. Orient the printed circuit board as shown in Photo. 1.
4. Install the locking hardware onto the screws on top of the printed circuit board.
5. Screw the nuts onto the screws, attaching the printed circuit board to the back panel. Center the printed circuit board vertically on the back panel to avoid interference with the system chassis when the back panel is installed in the system.

Tools Required

1. #2 Phillips screwdriver
2. 5/16 inch wrench or nutdriver

System Fan Removal

1. Perform system cover removal procedure.
2. Perform back panel removal procedure to step 7.

The system fan is mounted to the back panel using four screws. Each screw passes through the fan filter housing, the back panel, and the fan mounting flange. A nut and locking hardware attaches to each screw on top of the fan mounting flange. See Photo. 1.

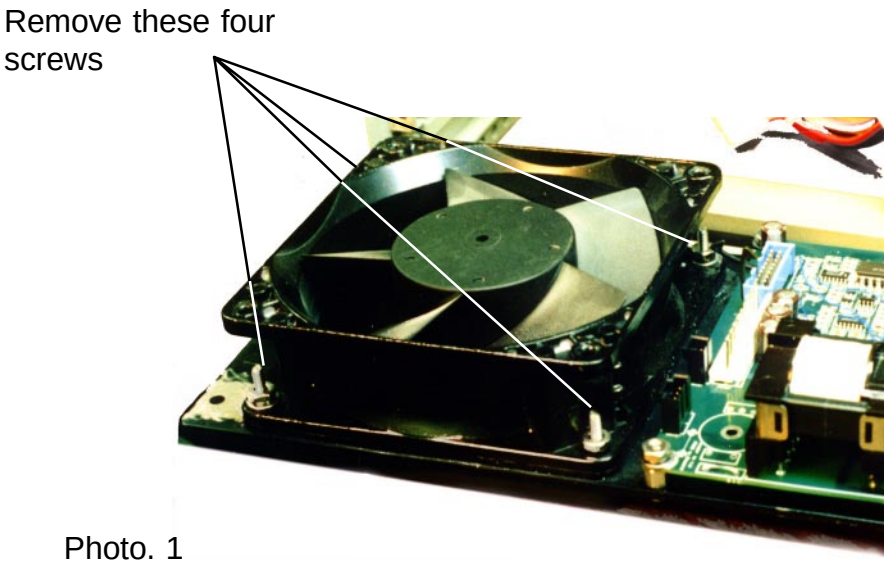


Photo. 1

3. Unscrew the four screws that attach the system fan to the back panel.
4. Set the hardware and fan filter housing aside for reuse.

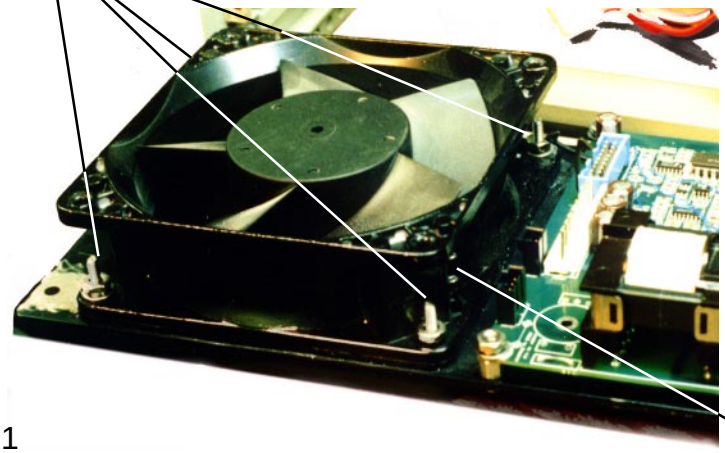
Tools Required

1. #2 Phillips screwdriver
2. 5/16 inch wrench
3. Refer to the tool requirement for all procedures referenced in this procedure.

System Fan Installation

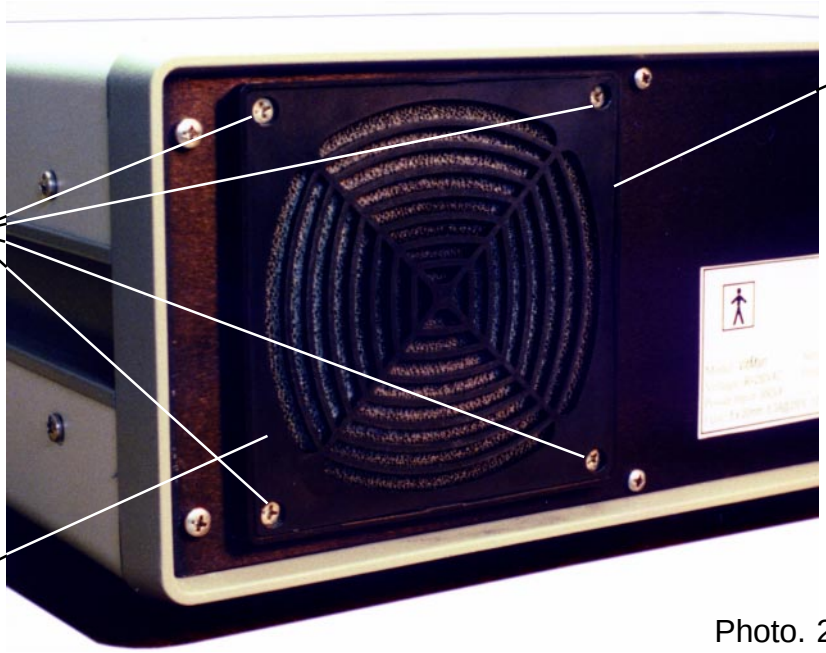
The system fan is mounted to the back panel of the system. The back panel should be partially removed from the system prior to installation of the fan. It isn't necessary to disconnect the foot pedal cable or system power wires from the back panel to install the fan. The fan is mounted to the back panel using four screws. Each screw passes through the fan filter housing, the back panel, and the fan mounting flange. A nut and locking hardware attaches to each screw on top of the fan mounting flange. The fan filter housing must be oriented to allow removal of the filter. The filter is retained in the housing with a snap in cover. See Photos 1 and 2.

Install these four screws



Power connectors go here.

Photo. 1



Fan filter housing.

Fan mounting screws

Snap-in filter cover

Photo. 2

1. Place the fan onto the back panel. Align the mounting holes in the fan mounting flange with the holes in the back panel. The fan should be oriented with the power connectors towards the upper middle of the back panel. An arrow is marked on the fan housing to indicate air flow. The arrow should point towards the inside of the system.
2. Insert the four screws through the fan filter housing, back panel, and fan mounting flange.
3. Install the locking hardware onto the screws on top of the mounting flange.
4. Screw the nuts onto the screws, attaching the fan and the filter housing to the back panel. Tighten the nuts.

Tools Required

1. #2 Phillips screwdriver
2. 5/16 inch wrench

Software Procedures

Load ***Syntec*** **VitMan** Software

Menu mode is required to load the system software from a floppy disk. To begin, place the software diskette into the floppy disk drive and enter menu mode. To enter menu mode, press and hold the blue "*Display*" button, located in the lower right corner of the ***Syntec*** **VitMan**. After one second the main menu help screen will display (see Figure 1). After reading the help screen, press the right arrow to move to the main menu. The dark band is the menu mode cursor (see Figure 2). The up and down arrow keys can be used to place the cursor over items within the menu. The right arrow character found at the end of a menu item indicates that pressing the right arrow button will move to another menu list. Using the down arrow, place the cursor on the "Disk Services" menu item (see Figure 3), then press the right arrow. This will display the disk services menu help screen (see Figure 4). Press the right arrow again to display the disk services menu list (see Figure 5). Using the down arrow, place the cursor over the menu item "Load Software" (see Figure 6). Press the right arrow to display the load software help screen (see Figure 7). Press the right arrow to move past the help screen to the load software command (see Figure 8). Press the *Enter* button to load the software. When the load is complete the ***Syntec*** **VitMan** will reset.

If a problem is encountered in the load process, the second line of the completion screen will indicate the error condition. If the disk is missing, the message "No diskette present" will be displayed. If the disk directory is unreadable, the message "Diskette failure" will be displayed. If the software image is not present, the message "VITMAN.TSK not found" will be displayed. If the file contents are incorrect, the message "Invalid task image", will be displayed. If the file contents are not for the ***Syntec*** **VitMan**, the message "Invalid device type" will be displayed. To exit menu mode, press the *Display* button.

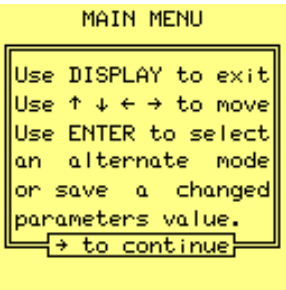


Figure 1

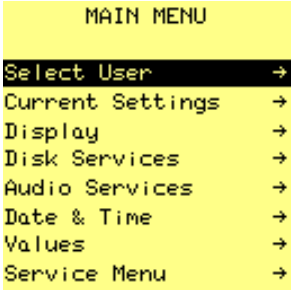


Figure 2

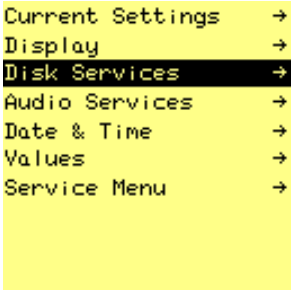


Figure 3

←DISK SERVICES
The following list has a toggle entry. Toggle entries are are marked by $ and may be toggled by pressing ENTER.
→ to continue

Figure 4

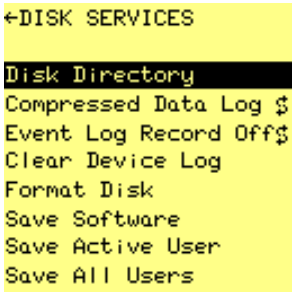


Figure 5

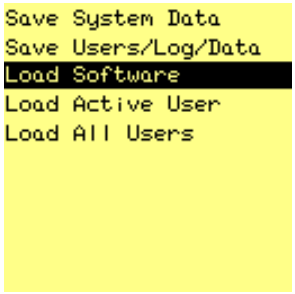


Figure 6

Loading Software
This command can be used to update the system software from disk. The file VITMAN.TSK will be loaded. This will take two minutes.
→ to continue

Figure 7

Figure 8

Save ***Syntec*** **VitMan** Status Information

Menu mode can be used to save the system status information on a floppy disk. The system status information can provide useful data to the ***Syntec*** customer service department. To begin, place a blank, write enabled, diskette into the floppy disk drive and enter menu mode. To enter menu mode, press and hold the blue "*Display*" button, located in the lower right corner of the ***Syntec*** **VitMan**. After one second the main menu help screen will display (see Figure 1). After reading the help screen, press the right arrow to move to the main menu. The dark band is the menu mode cursor (see Figure 2). The up and down arrow keys can be used to place the cursor over items within the menu. The right arrow character found at the end of a menu item indicates that pressing the right arrow button will move to another menu list. Using the down arrow, place the cursor on the "Disk Services" menu item (see Figure 3), then press the right arrow. This will display the disk services menu help screen (see Figure 4). Press the right arrow again to display the disk services menu list (see Figure 5). Using the down arrow, place the cursor over the menu item "Save All Users" (see Figure 6). Press the right arrow to display the saving all users help screen (see Figure 7). Press the right arrow to move past the help screen to the saving all users command (see Figure 8). Press the *Enter* button to save all of the user settings (and system status information) on the disk, in the file VITMAN.CFG. When the save is complete, three tones will sound and the bar graph will indicate completion (see Figure 9). If a problem is encountered in the save process, the second line of the completion screen will indicate the error condition. If the disk is missing, the message "No diskette present" will be displayed. If the disk directory is unreadable, the message "Diskette read failure" will be displayed. If the disk is write protected, the message "Disk write protected" will be displayed. If the disk does not have sufficient space to save the entire file, the message "Insufficient space" will be displayed. If a sector fails to verify, the message "Diskette failure" will be displayed. To exit menu mode, press the *Display* button.

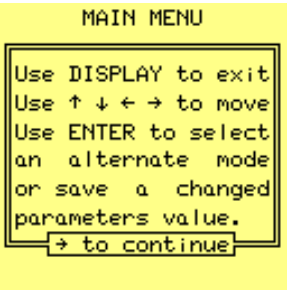


Figure 1

Figure 2

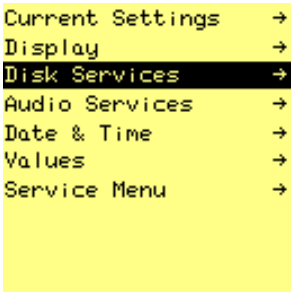


Figure 3

←DISK SERVICES
The following list has a toggle entry. Toggle entries are are marked by $ and may be toggled by pressing ENTER.
→ to continue

Figure 4

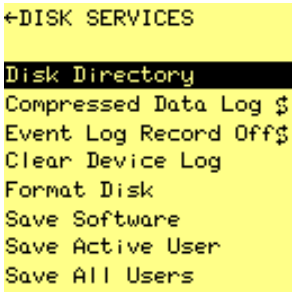


Figure 5

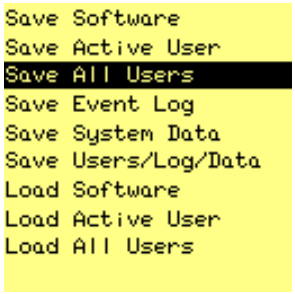


Figure 6

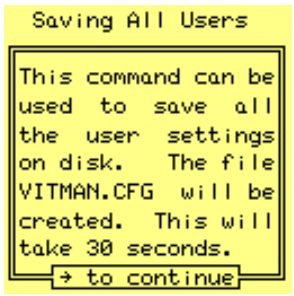

Saving All Users
This command can be used to save all the user settings on disk. The file VITMAN.CFG will be created. This will take 30 seconds.
→ to continue

Figure 7

Figure 8

Figure 9

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